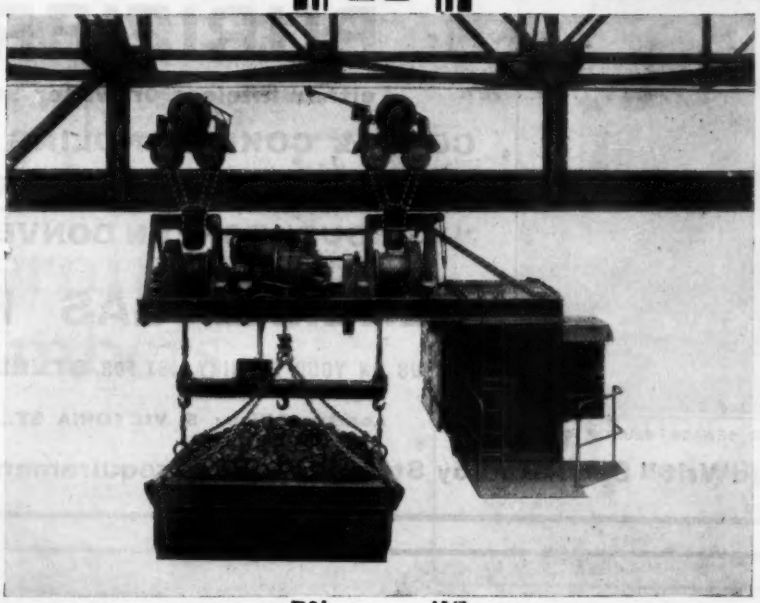
GAS JOURNAL

LIGHT . HEAT . POWER . BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

Vol. 204. 85th Year. LONDON, NOVEMBER 15, 1933. No. 3678. Price 1s.

ELECTRIC ALL TYPES | **TELPHERS** ALL CAPACITIES



For Direct or Remote Control

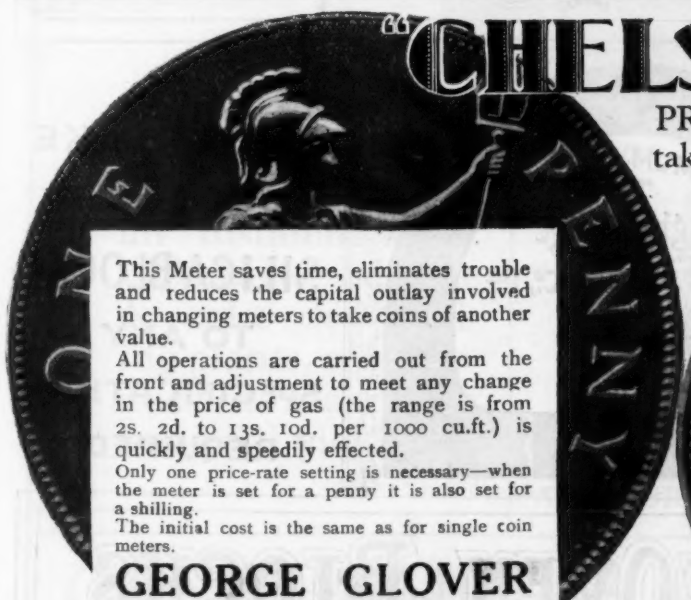
For handling Coal, Coke, Oxide, etc., by means of Skips or Grabs.

The illustration shows a 7-Ton Gross Load, three barrel machine for handling coke from Intermittent Vertical Retorts.

STRACHAN WHITEHALL & **HENSHAW LTD.** BRISTOL

"CHELSEA TWO"

PRE-PAYMENT METER
takes PENNIES and SHILLINGS



This Meter saves time, eliminates trouble and reduces the capital outlay involved in changing meters to take coins of another value.

All operations are carried out from the front and adjustment to meet any change in the price of gas (the range is from 2s. 2d. to 13s. 10d. per 1000 cu.ft.) is quickly and speedily effected.

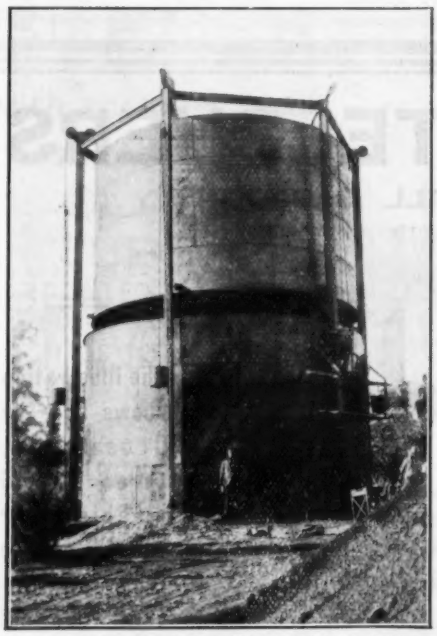
Only one price-rate setting is necessary—when the meter is set for a penny it is also set for a shilling.

The initial cost is the same as for single coin meters.

GEORGE GLOVER
& COMPANY, LIMITED.
'Phone: Sloane 7257—58. *Ranelagh Works,* Wires: "DRY METERS, Phone, London."
CHELSEA, S.W. 3.
Branches— LEEDS & MANCHESTER.

HEAD, WRIGHTSON, & Co., Ld.

THORNABY-ON-TEES and STOCKTON-ON-TEES



GASHOLDER FOR SEWAGE SLUDGE GAS

have foundries with an output of over 100,000 tons annually and are specially equipped for turning out

GASHOLDERS
PURIFIERS

either luteless or water sealed

COAL & COKE HANDLING PLANTS,
PAN ASH WASHERS,
"MARCUS" SCREEN CONVEYORS, &c.

GENERAL GAS PLANT

PUT US ON YOUR ENQUIRY LIST FOR STEEL CASTINGS

London Office: **5, VICTORIA ST., S.W.1.**

"HedWrit" Special Alloy Steels to suit all requirements.

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MINIMUM EXPANSION
The Oughtibridge Silica Firebrick Co., Ltd.
Oughtibridge, Near Sheffield.
Estd 1858.

WE UNDERTAKE TO MANUFACTURE SILICA BLOCKS TO ANY SPECIFICATION REQUIRED.

COKE OVEN BLOCKS.

DESIGNERS & BUILDERS
OF
MODERN
CARBONIZING PLANT
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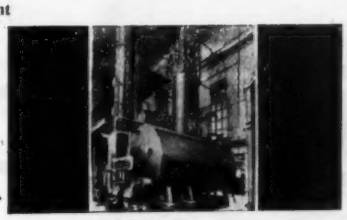
C.O.L. vertical intermittent chambers

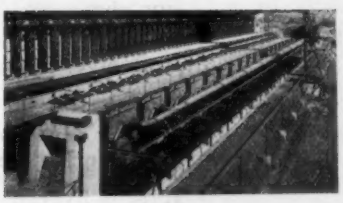
will increase your operating efficiency, and, together with—

A 10-million cu. ft. plant



A benzole plant

an installation of COLLIN benzole & coke dry cooling plants, will produce a maximum financial yield

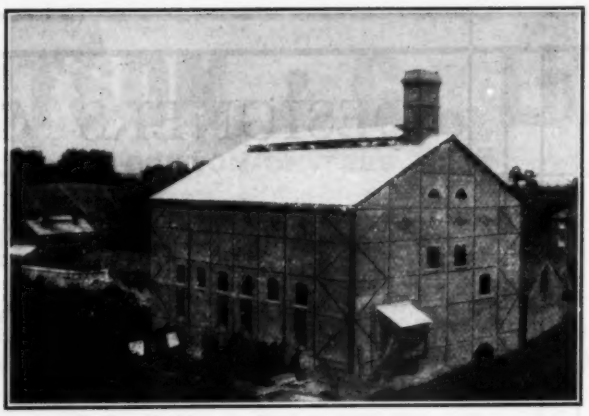


A coke dry cooling plant

AT YOUR DISPOSAL

GAS CHAMBERS & COKE OVENS LTD.
ARTILLERY HOUSE WESTMINSTER, S.W.1
VIC. 7912

Complete Retort Installations and all Gas Works Plant . - .



EXTERIOR AND INTERIOR VIEWS OF TWO RECENT INSTALLATIONS.
(Congdon System and Steelwork by Messrs. Aldridge & Ranken Ltd.)

F. C. SUGDEN & Co. LTD.
GASWORKS CONTRACTORS
10, EAST PARADE, LEEDS 1.

Telegrams: "CARBONIZER." *Telephone:* 25203 LEEDS.

PREPARED STAVELEY OXIDE

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Whilst there is no question of reconditioned burnt spent oxide being used in the product advertised — the Staveley Company, however, are regular and large buyers of spent oxides for use in other branches of their Chemical manufacturing business. This may be worthy of your notice.

For many years past, discerning Gas Managers up and down the country have found that Staveley Prepared Oxide of Iron gives unusually good results in their Purifier Plants.

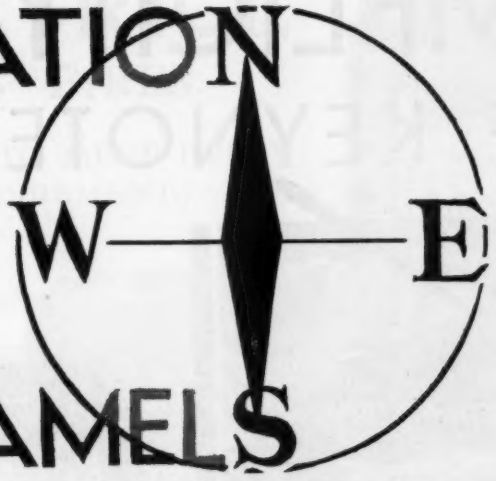
This is due to the fact that this well-tried Staveley product is a ★*VIRGIN* material, specially and solely prepared for Gas Works use.

It is delivered ready for use and, whilst by no means expensive, it gives consistently good results.

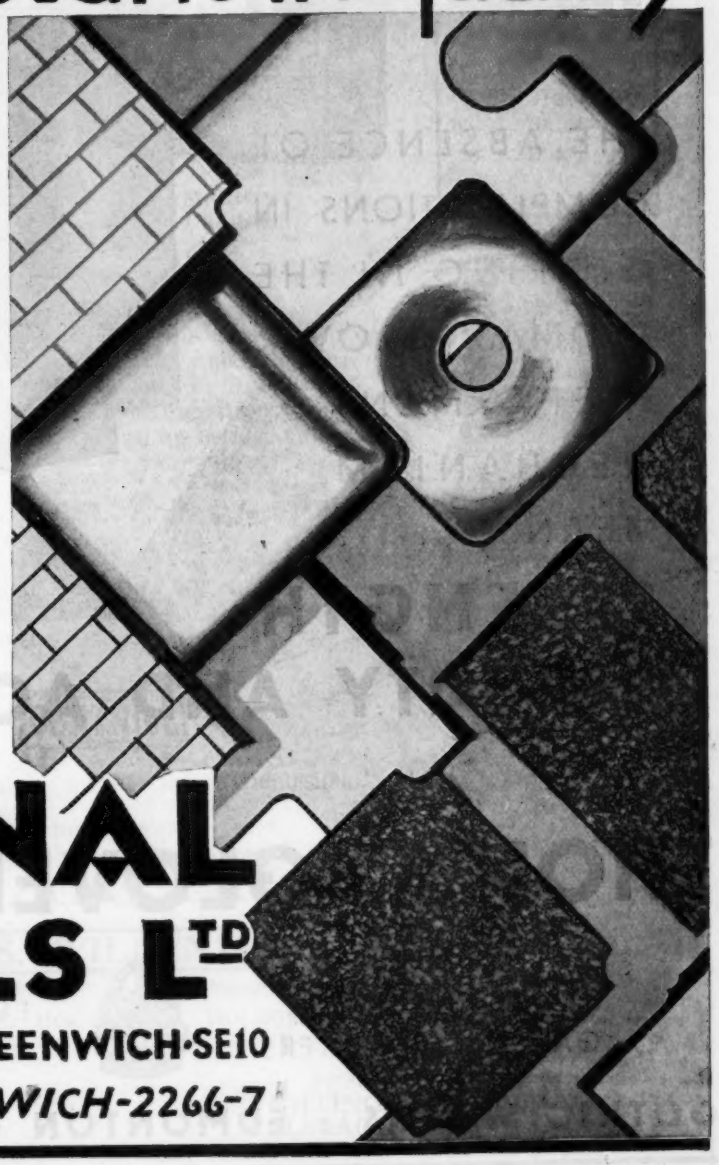
Full particulars and samples will gladly be sent upon request.

THE STAVELEY COAL & IRON Co LTD
NEAR CHESTERFIELD

NO VARIATION



IN OUR ENAMELS
—constant in quality



Pursue the safest course and place your orders for heat-resisting enamelware with an undertaking which specializes in this class of work.

"Constancy" is our watchword, and our linings, trays, and splash plates are noted for their excellence of quality, workmanship, and design.

For further particulars apply—

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ENAMELS LTD
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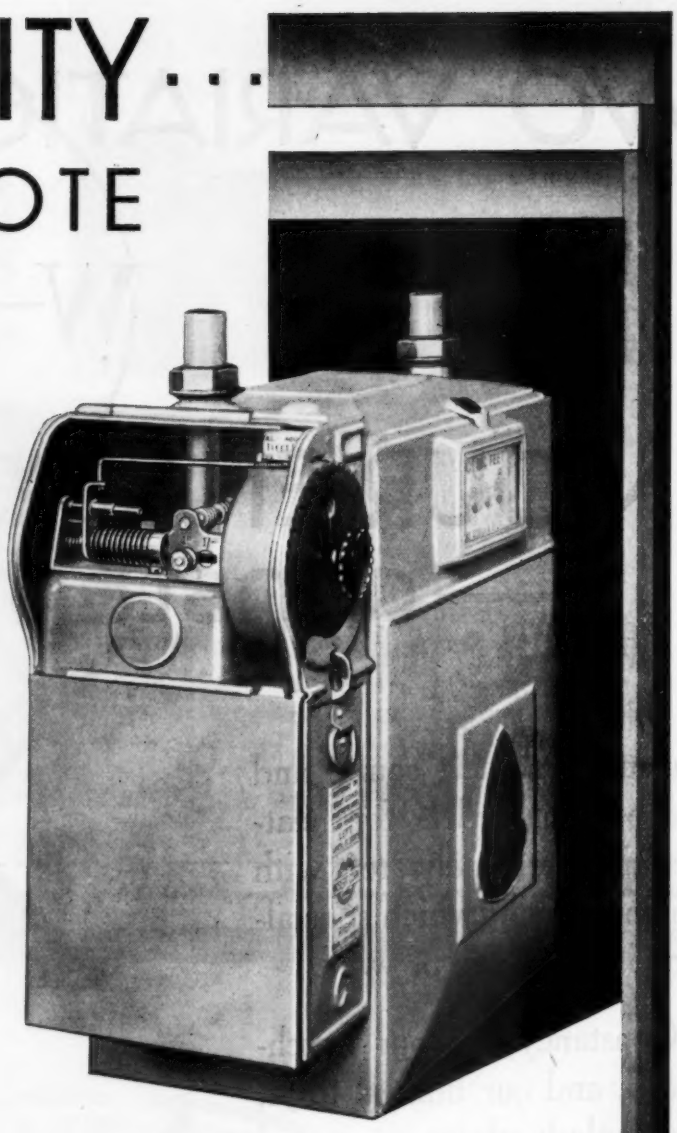
SIMPLICITY...
THE KEYNOTE



THE ABSENCE OF COMPLICATIONS IN GEARING IN THE THOMAS GLOVER PREPAYMENT MECHANISM MEANS . . . . . .

STRENGTH RIGIDITY AND ACCURACY

THOMAS GLOVER & Co LTD

ORIGINAL DRY GAS METER MAKERS

ESTABLISHED IN 1844

GOTHIC WORKS : EDMONTON : LONDON, N.18

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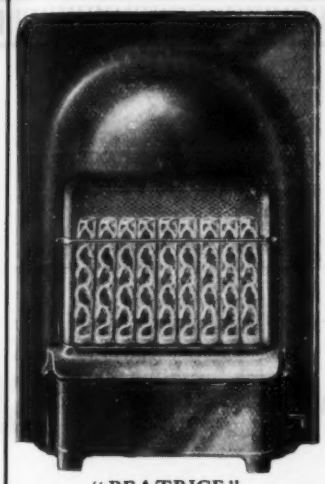
GAS FIRES

A DESIGN TO MEET EVERY REQUIREMENT



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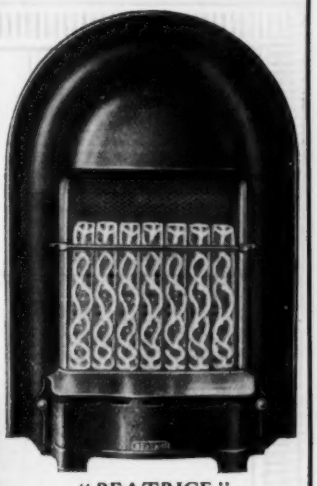
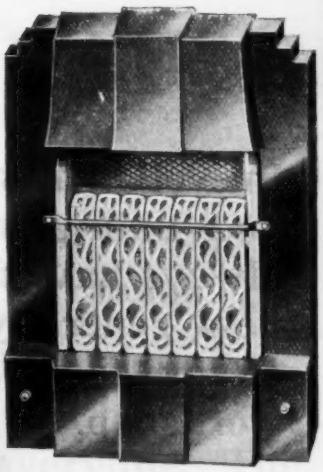
5, 7 or 9 Radiant
(Square Top).

FITTED WITH TRIPLE DISINTEGRATING INJECTORS GIVING COMPLETE INCANDESCENCE AT MODERATE GAS PRESSURES.



"BEATRICE"
5 or 7 Radiant
(Round Top).



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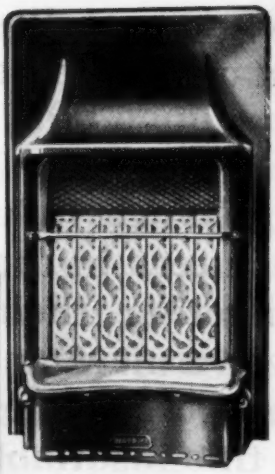
7 Radiant.

FINISHES

ART BLACK VITREOUS ENAMELS AND CHINESE LACQUERS IN A WIDE VARIETY OF COLOURS.

ALL FIRES FINISHED WITH CHINESE LACQUER ARE SUPPLIED WITH NICKEL PLATED FENDERS, THE PRICES BEING THE SAME AS FOR ART BLACK FIRES.



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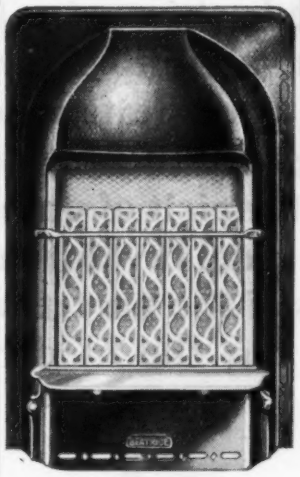
ALL FIRES ARE SUPPLIED WITH "BEATRICE" SUNGLOW RADIANTS HAVING ALL THE CONSTITUENTS FOR HEALTHY EFFICIENT HEAT.



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PEDESTAL AND SWING BOILING BURNERS CAN BE SUPPLIED AS REQUIRED.

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BEATRICE
MADE IN ENGLAND

SILENT IN LIGHTING, BURNING AND EXTINGUISHING.

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ECONOMIC GAS BOILER CO., LTD.
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THE "PIONEER SPR

In every industry that keeps its virility fresh and unimpaired, the pioneer spirit must always have first place. In practical business generally, success lies in the ability always to see a considerable way beyond the workshop.

In the Gas Appliance Industry, Radiation Limited are pioneers in the best sense. To the minds directing their activities, the industry is ever a new and fertile field of promise, whose possibilities are inexhaustible; and it is this insatiable spirit of enterprise that has, in the last decade, revolutionised all previous conceptions of the part that gas could be made to play, in the modern home.

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PRIT" IN INDUSTRY

met again and again by improvements in appliances that have captured anew and held the popular taste.

The long list of constructional developments initiated and popularised by Radiation Limited is known to everyone. The instant success of the "New World" Cooker is itself a justification (if any were needed) for the untiring spirit of research that is a foremost part of the Radiation programme. Such an "organisation that never rests" can be a source of real help to the industry by which its own success must always be governed.

Radiation
LIMITED

THE MELTHAM SILICA FIRE BRICK

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STAND AT THE BRITISH INDUSTRIES FAIR, BIRMINGHAM, 1933.

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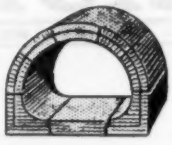
MANUFACTURERS OF HIGH-CLASS

SILICA BRICKS AND BLOCKS

for GAS WORKS and COKE OVEN PLANTS

To any Design. ***As Supplied to some of the Largest Works in the Country.***

VERTICAL and SILICA  HORIZONTAL RETORTS

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SAMPLES FORWARDED ON REQUEST.

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Staveley Sand Spun Pipes represent British Foundry technique at its very highest pitch of perfection.

Here are cast iron pipes free from cavities, blow-holes, and dirt—pipes that are stronger, tougher, more elastic, and more resistant to shock.

Staveley Sand Spun Pipes are 25% lighter than the more usual vertical cast pipe of similar size and class—this means 33% more pipe for equal weight and thus saving in transport and handling.

Less joints are required with Sand Spun Pipes owing to their 16' 0" length.

Staveley Sand Spun Pipes are ideal for application as water and gas mains.

Staveley Sand Spun Pipes are supplied in 16-ft. lengths, and all diameters 4" to 18", but sizes up to 24" will be available early in 1934.

We are Exhibiting PUBLIC WORKS EXHIBITION NOVEMBER 1933

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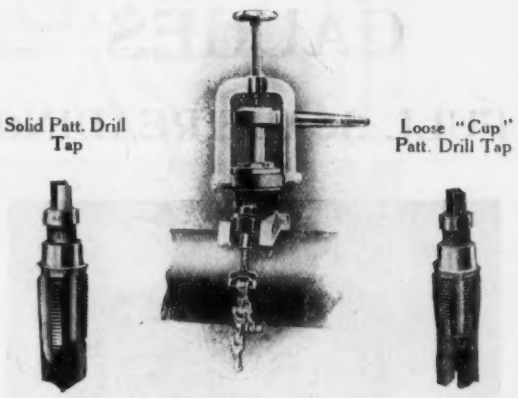
THE STAVELEY COAL & IRON COMPANY LIMITED

Nr. CHESTERFIELD

The Largest Main-Laying Contractors in the Country use "Abbirko" Central Action Drill Stands and Tools



For drilling and tapping mains accurately and quickly with minimum loss of Gas.

They use them **All day and Every day** knowing that better machines and tools are unprocurable.

ABBOTT, BIRKS & CO.

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For all Tools and Equipment. See our Catalogue No. 30.

HAWKINS

IMPERISHABLE

IRON CEMENT

For Gas Works repairs, Leaks in Gas Holder Seams, Scrubber Joints, Storage Tanks, Retorts, etc.

Used by over 1,000 of the leading Gas Works for the past 16 years

The success of these products has led to numerous imitations. ***See that you get "HAWKINS"***

Sole Manufacturers:

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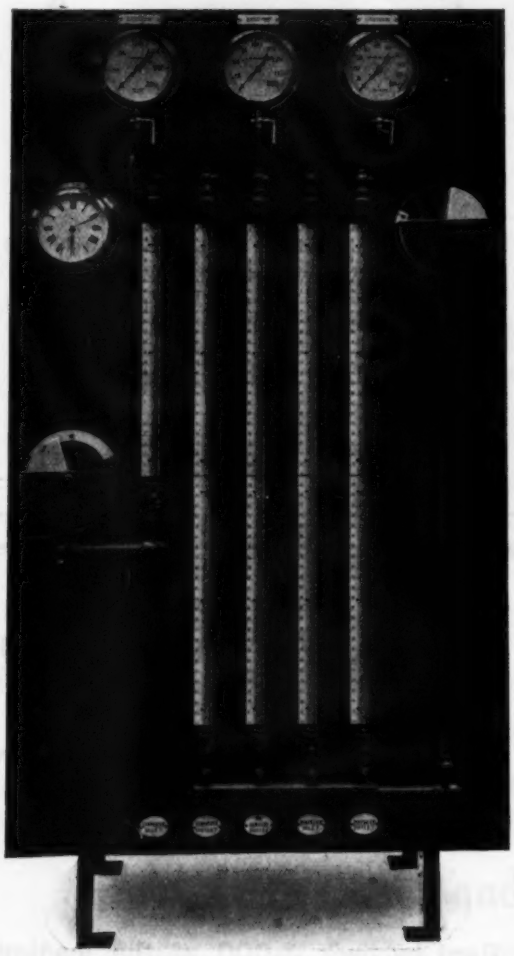
Manufacturers of HAWKINS IMPERISHABLE JOINTING CEMENT, HAWKITE ROOFING PLASTIC, HAWKITE PAINT, HAWKINS :: :: PLASTIC FIRE CEMENT :: ::

SINGLE TUBE PRESSURE GAUGES

FULL SCALE READING



METERS

MILNE'S Two Coin Meter

For Pennies and Shillings.

May also be set for Pennies only.

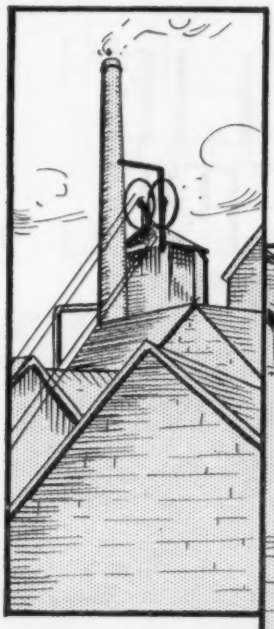
May also be set for Shillings only.

MILNE'S METERS LTD.

MILTON HOUSE WORKS, EDINBURGH.

LEEDS BRANCH: Midland Meter Works, Victoria Road.

"Portcullis" gas fires have been enthusiastically received by the Gas Industry as a remarkable step forward in gas-fire technology.



FROM
MINE
TO
MACADAM

BY THE DIRECT ROUTE.

TREAT YOUR
COAL TAR

FROM
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OR **PRODUCER-GAS PLANTS**

BY THE PATENT
CASCADE PROCESS
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BRITISH TAR FOR BRITISH ROADS

SEND YOUR ENQUIRIES TO

CLAYTON SON & CO., LTD.,
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SUPER HIGH CAPACITY METERS

SMALL SIZE LARGE VOLUME LOW PRICE

ACCURATE REGISTRATION MINIMUM LOSS

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DOUGALL'S
SUPER HIGH CAPACITY METERS

Large Capacity in Small Case. Correct Registration from Pilot Jet to Peak Loads with absorption and oscillation practically negligible.

Also in
LIGHTS,
STANDARDS
and HIGH CAPACITY

These Meters can be fitted with our Two-Coin Mechanism which can be altered in a few seconds.

This type of Meter is unique for Housing Schemes.

May we send you a sample for test?

DOUGALL'S GAS METERS LTD.
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"Tully" Gas

The ideal gas suited to all modern needs

Economical in Use and Cheap to Produce

There are several hundred "Tully" plants in use and numerous gas works are sending out all "Tully" gas

Sole Makers and Patentees:

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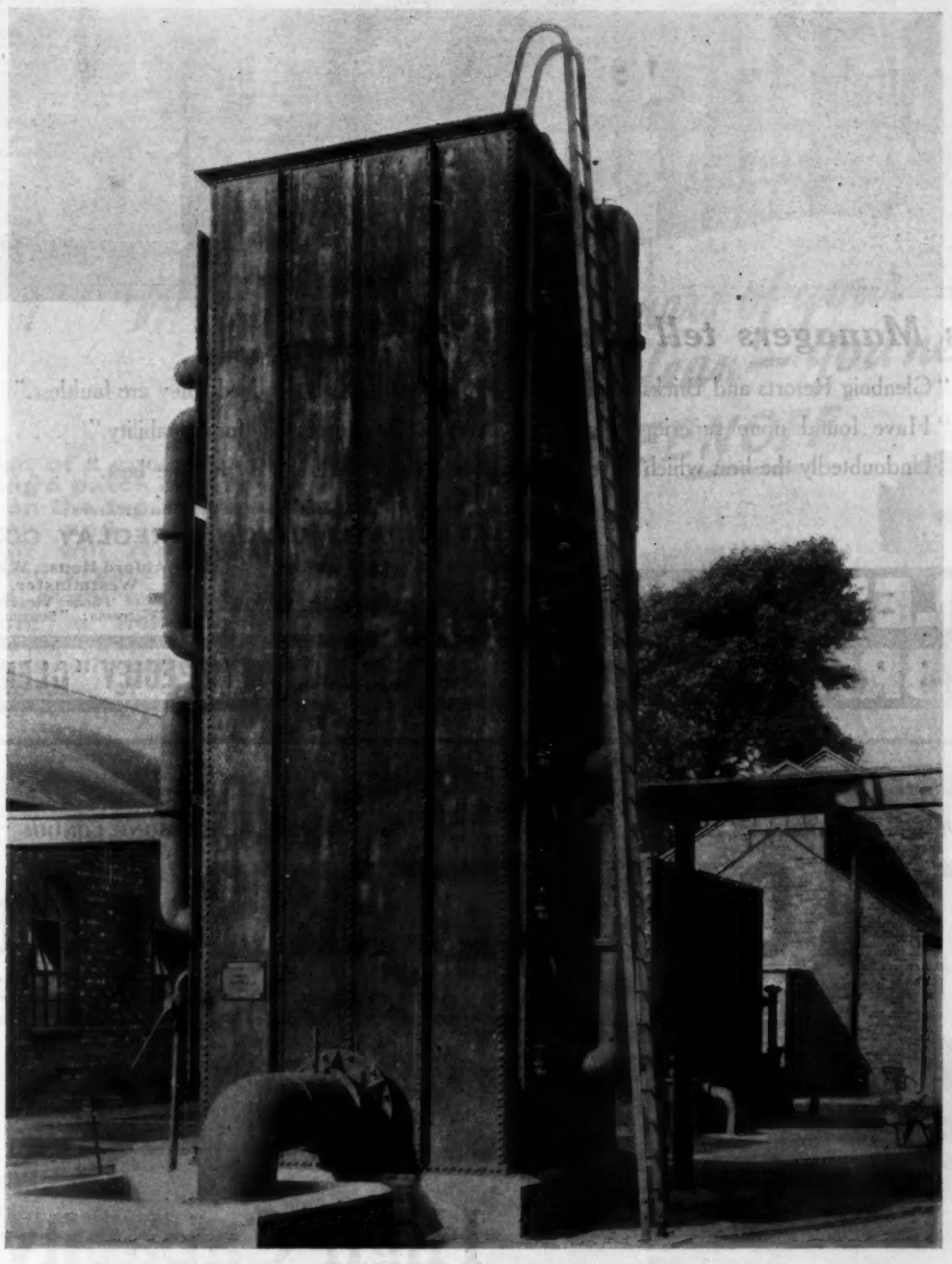
Condensers



R. & J. Dempster Ltd. manufacture and erect all types of Condensing Plant for Liquids and Gases. Your enquiries will receive prompt and careful attention.

R. & J. Dempster LTD. Gas Plant Works
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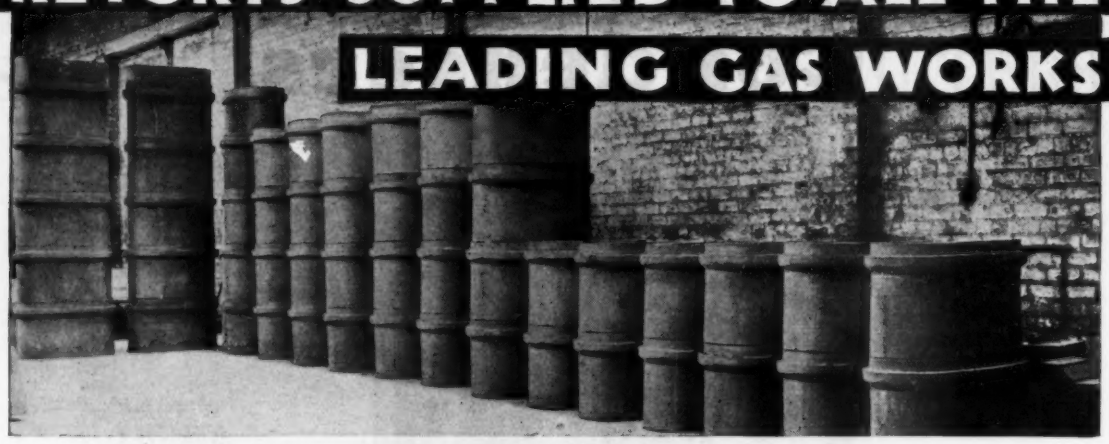
RETORTS SUPPLIED TO ALL THE LEADING GAS WORKS



Gas Managers tell you why

"Glenboig Retorts and Bricks have given complete satisfaction—indeed, they are faultless."
"Have found none superior." . . . . "Cannot be surpassed for durability." . . .
"Undoubtedly the best which have been used here." . . . . "By far the best." . . .

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FOR ASSURED ECONOMY SPECIFY "GLENBOIG"

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THE GAS METER Co., LTD.

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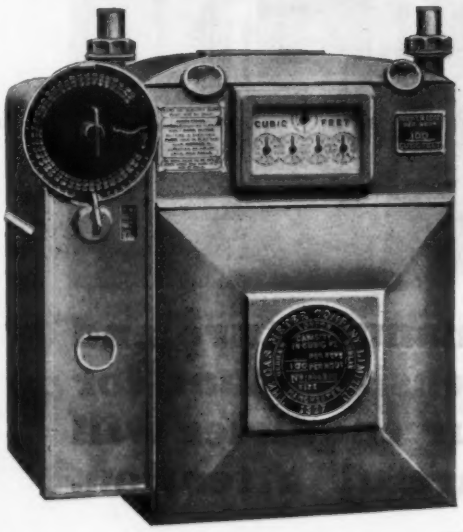

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High Capacity
Tinplate Case
Dry Gas Meters.

BRANCHES: OLDHAM, Union St. Works. DUBLIN, Hanover St. Works. MANCHESTER, 70, Great Bridgewater St.

Kleenoff
REGISTERED
cleans cookers

WITHOUT RUBBING OR SCRUBBING

You can't rub the back & corners of your cooker clean—You need **KLEENOFF**

The test of a good cleaner is not cleaning a patch on an oven door. Try it on the top inside and back of oven and in the corners. Kleenoff will remove the hard baked-on grease from all parts of the oven without rubbing! Kleenoff is non-abrasive and completely odourless; therefore, it cleans without harming the fine surface of enamel linings, and leaves the oven sweet and fresh.

Consistently and Extensively advertised

10D.

per large tin, Retail

Supplied in ½-cwt. Drums and 14-lb. tins extra strong for use in Stove Shops.

NOTE THE NUMBER OF CONSUMERS THAT ASK FOR KLEENOFF

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(PROPRIETORS: BALE & CHURCH, LTD.).

Messrs. Westwood & Wrights, Ltd.,
Gasholder and Engineering Works, Brierley Hill,

Give Notice to the Public

that the well-known face lubricated disc Valve manufactured by them for incorporation in gas manufacturing and supply systems constitutes the subject of British Letters Patent No. 314,732 and that they will take such action as they may be advised in order to protect their rights against any users or manufacturers of valves which

INFRINGE THE SAID PATENT

METERS
PRESSURE GAUGES
SYPHON PUMPS

SLOT METERS
Simple, Strong, Compact, Accurate
1d. or **1s.** or **Two-Coin**

Station Meters, Test Meters, Brasswork

DRY GAS METERS
Standard and High Capacity

Sole Agents in Scotland for "RENRUT" SERVICE CLEANSERS

DAVID GRANT & CO.,
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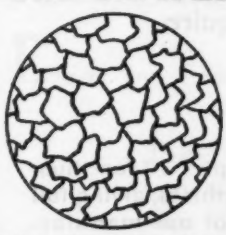
USE IT

BECAUSE:

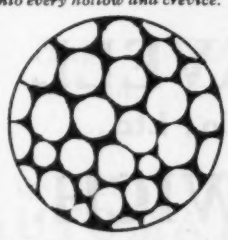
- The pigment is hard, foliated Silica-Graphite, which is inert to the fumes met with in Gas Works.
- The minute, slate-like flakes overlap and form with the tough "linoxyn" film of oil a protective covering which fills up all interstices and effectively withstands corrosion. (See illustrations alongside).
- It has excellent covering power and is easy to apply, thus reducing labour costs.
- It lasts for years, and results in all-round painting economy.

WRITE *for Free Booklet "Foliac Paints," and read 21 more concrete reasons why Foliac Silica-Graphite paint is the ONLY paint that can give adequate protection to all engineering structures.*

FLAKES LIKE SLATES



Foliac Silica-Graphite Paint is made up of flat flakes that overlap like slates on a roof, and pack into every hollow and crevice.



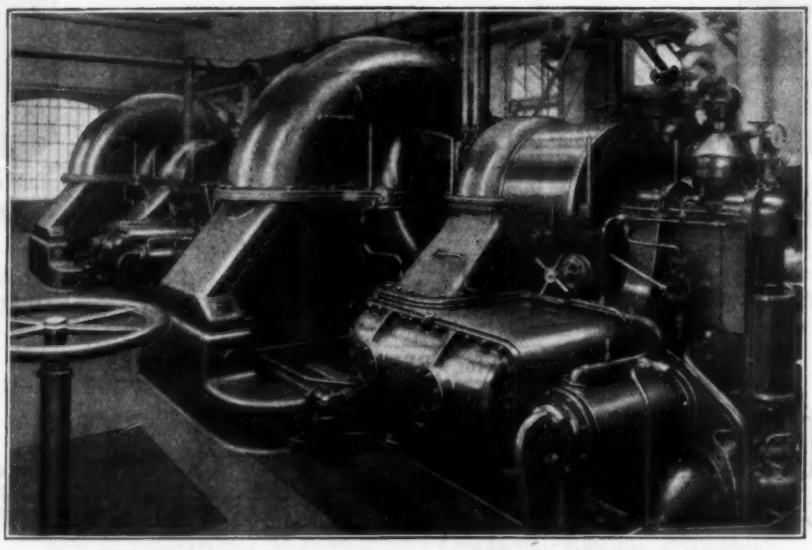
Ordinary amorphous paint covers like this! Being globular grains, they do not fit closely, nor do they cover adequately.

Foliac

SILICA-GRAPHITE PAINT
GRAPHITE PRODUCTS LTD.

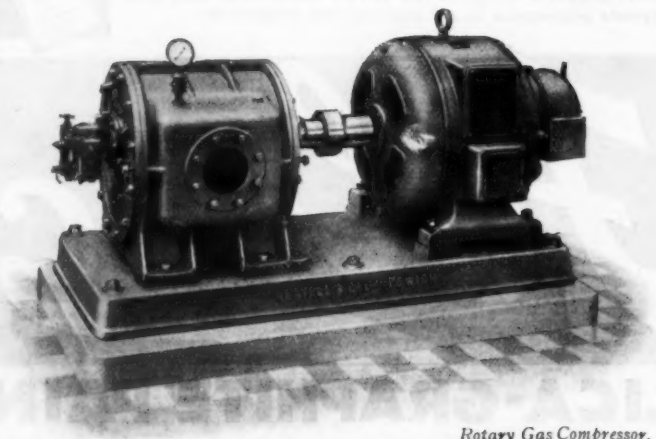
52, CHURCH ROAD, BATTERSEA, S.W.11. *Telephone: 0521 Battersea.*

GAS BOOSTERS & COMPRESSORS.



Illustrated above are two Turbo Boosters with capacities of 2,000,000 cubic feet of gas per hour each. They are direct-coupled to Steam Turbines.

We have supplied numbers of Steam Turbine and Motor Driven Exhausters for Coke Oven Plants; Steam Turbine, Motor and Gas Engine Driven Gas Boosters and Rotary Compressors for Transmission and Distribution Purposes; Portable Compressor Units for Breaking up Roadways with Pneumatic Picks for Laying Gas Mains, and for Caulking and Testing Pipe Lines; and Turbo Blowers for Water Gas Plants. If you send us particulars of your requirements we will quote you for suitable plant.



Rotary Gas Compressor. 120,000 cu. ft. per hour.

Write to Dept. "J" for illustrated pamphlets, giving full particulars of our manufactures.

REAVELL & Co., Ltd., IPSWICH.

Telegrams: "REAVELL, IPSWICH."
Telephone: 2124 & 2125 IPSWICH.

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"GUNFIRE" (TRADE MARK)

THE

Guarantee of Satisfaction

Universally used

Necessary for Automatic Lighting

First and Pioneer

Imitated, never equalled

Reliable in action

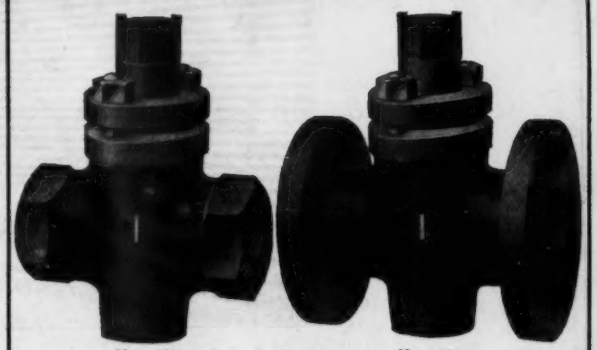
Efficient and Economical Service

There is a complete range of "GUNFIRE" Controllers to meet every lighting requirement.

Have "GUNFIRES" and no regrets

BRITISH, FOREIGN & COLONIAL
AUTOMATIC LIGHT CONTROLLING Co., Ltd.
BOURNEMOUTH

HAUGHTON'S HEAVY TYPE CAST IRON GLAND COCKS



No.—113 FOR No.—114

STEAM, WATER, GAS, AMMONIACAL LIQUOR, TAR, AND CHEMICALS

ALL SIZES IN STOCK

HAUGHTON'S PATENT METALLIC PACKING Co. Ld.
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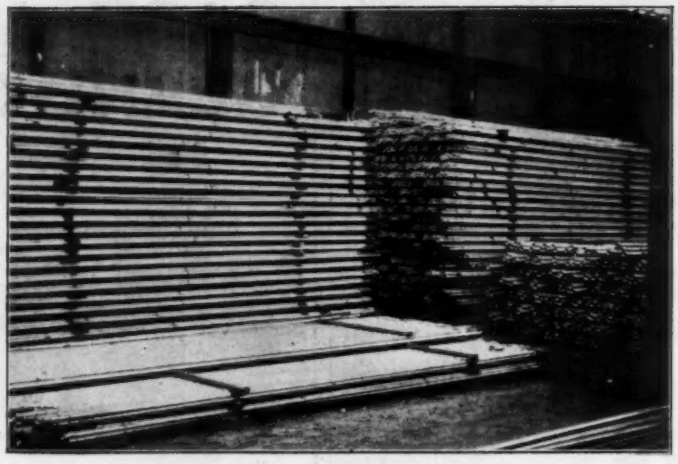
PHONE - ROYAL 1383

CONFIDENCE!

MALTON
ANNAN
TADCASTER
REVERTED
FROM ELECTRICITY TO GAS
FOR STREET LIGHTING

THE COMPLETE EQUIPMENT
WAS MADE AND SUPPLIED BY
MESSRS. FOSTER & PULLEN LTD.
BRADFORD

Tubes for the Gas Industry



Our Warehouses can supply you with them promptly.

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MANCHESTER—14, Chapel St., Victoria Bridge.
LEEDS—44, Victoria Road, Holbeck.
SHEFFIELD—Palm Tree Works, Staniforth Road.
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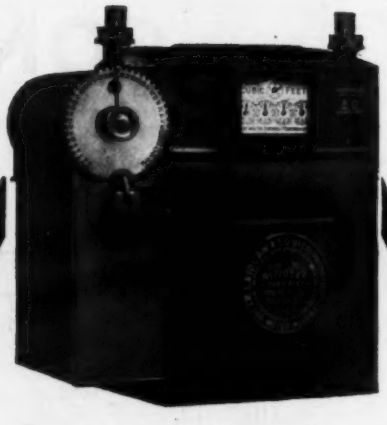
NEWCASTLE-UPON-TYNE—Railway Arches, Manors Station.
CARDIFF—Collingdon Road, Bute Docks.
ST. AUSTELL—West Bridge.

or write direct to

THE SCOTTISH TUBE CO., LTD., 34, ROBERTSON ST., GLASGOW



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STANDARD ALSO HIGH CAPACITY
SLOT & ORDINARY METERS

Nothing but the best materials and workmanship used in their manufacture

Repairs——Parts supplied

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FOUR OAKS SPRAYERS

FOR EASY LIME WASHING AND LIQUID CEMENT SPRAYING IN HOT VERTICAL GAS RETORTS

These sprayers are both labour-saving and effective in performance. They have proved themselves in many gas undertakings, and gas engineers using them consider they are all that we claim for them. Specialising in spraying apparatus, our wide range of productions includes machines for whitewashing, disinfecting, creosoting and paint spraying. Tell us your spraying problem—our long experience can help you.

The "FOUR OAKS" Gold Medal "Bridgwater" Pattern

The special feature of this pump is that the pump bucket works entirely outside the liquid.

18 Gallons

£17 10 0

Other patterns of smaller capacity and lower prices

Catalogues and full particulars sent free on application to the Sole Manufacturers.

"THE FOUR OAKS"
SPRAYING MACHINE CO.
"FOUR OAKS" WORKS
SUTTON COLDFIELD, BIRMINGHAM

Telegraphic Address: Sprayers, Four Oaks. Telephone No.: 305 Four Oaks.

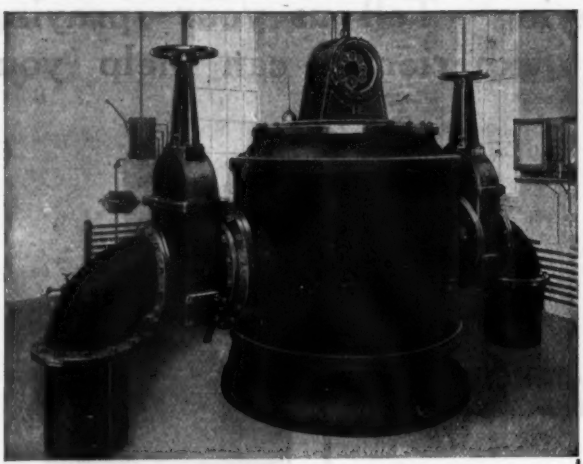
The "No-Trouble" Burner

THE 790DS. BURNER is fitted with the BRAY SILENT REGULATOR and the BRAY PATENTED DIFFUSER.

This combination is the most important advance in incandescent burner design for many years: IT BANISHES NOISE.

BRAY 790DS BURNER

GEO BRAY & CO LTD LEEDS



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LOW MAINTENANCE COST

ROTARY METERS —

BRITAIN'S BEST INFERENTIAL STATION METERS.

CHEAP

ACCURATE

RELIABLE

USED IN PRACTICALLY EVERY COUNTRY WHERE GAS IS MADE.

Special Low Prices now in operation

THE ROTARY METER COMPANY LTD.
TALBOT ROAD, STRETFORD, MANCHESTER

IF YOU ARE MANUFACTURING AND SELLING

GAS PRODUCING PLANT
GAS CONSUMING PLANT OR
GAS

POWERS PUNCHED CARD ACCOUNTING

WILL HELP YOU
TO INCREASE YOUR
PROFITS

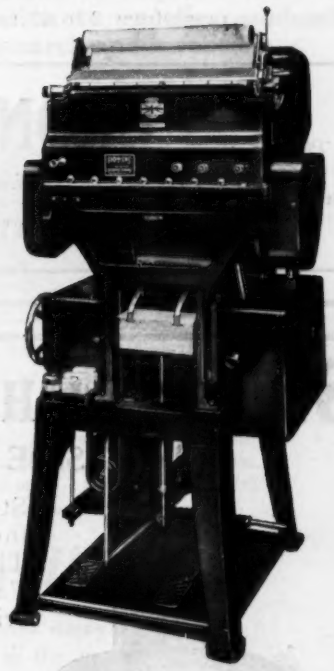
HERE IS WHAT A FEW USERS SAY:—

"The most attractive feature of your Punched Card Method is undoubtedly the savings we have been able to effect by control of Expenses in the Shops."

"I can definitely state that I could not produce the required monthly Balance Sheet and Accounts within a reasonable time without your machines."

"We have proved that Powers Punched Card Accounting is vitally necessary to us."

"Our installation of Powers is not only an efficient method of obtaining our accounting results, but a great saving of cost—both in time and money."



Powers Alphabetical Printing Tabulator.

Powers Punched Card Accounting Machines represent the highest development of true mechanical accounting. The records are made, collated and tabulated by machines —operated by positive mechanical means—giving accurate results at machine speed.

Powers Punched Card Accounting Equipment is capable of performing all book-keeping operations including Costing, Payroll and Wages Analysis, Stock Control, Manufacturing and Selling Costs, Stores Accounting, Purchases and Sales Analyses, and Customers' and Suppliers' Accounts—in fact, all necessary accounting and statistical records, from original entry up to Profit and Loss Account and Balance Sheet.

Write to-day for new descriptive booklet to—

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C. & T. OXIDE DISINTEGRATORS

C. & T. DISINTEGRATORS were first used in the Gas Industry in 1910. To-day they are at work all over the world.

Free demonstrations are given anywhere in the United Kingdom.

Capacities range from 2 to 60 tons per hour.

C. & T. PORTABLE CONVEYORS

PORTABLE CONVEYORS have many uses in the Gas Industry—loading Coke, turning Oxide, stacking Coal, etc.

We make special Machines for charging and discharging Purifiers.

Portable Conveyors save up to 66% of handling costs.

'Phone: **3397 St. Helens**

CRONE & TAYLOR Ltd.

Disintegrating and Conveying Engineers

Sutton Oak, St. Helens, Lancs.

'Grams: **Crone Taylor Suttonoak**

STREET LIGHTING IN COUNTRY DISTRICTS

OUTSIDE THE AREA OF GAS SUPPLY

O.L. 55.

Outdoor Suspension Lamp
300 c.p. 82/6
500 „ 90/-

BRITISH MADE THROUGHOUT.

Street Lighting has frequently to be provided in districts where the cost of extending the gas service would be prohibitive. This difficulty can be overcome by installing Tilley Paraffin Vapour Lamps, which are self-contained and give an extremely brilliant light at almost negligible cost. We recommend—

The Tilley Outdoor Suspension Lamp

Made in two sizes: 300 c.p. and 500 c.p.

BURNS ORDINARY PARAFFIN. WIND AND RAIN PROOF.

This method of lighting is being introduced by several Gas Undertakings with excellent results. The Lamps are very simple to manage and the cost of maintenance for 1000 burning hours (including paraffin) works out at considerably less than 20/- per Lamp. This is equivalent to—

4 HOURS LIGHT FOR 1d.

If required, we can supply a Lamp suitable for fitting inside existing lanterns.

Widely used by the leading Railway Companies all over the World.

Sample Lamp for testing purposes willingly sent without obligation to purchase.

THE TILLEY LAMP CO., HENDON, N.W.4.

Telephone: Hendon 8045 (2 lines).

NEWBRIDGE

Gas Switches

Newbridge Gas Switches are being installed in increasing quantities by progressive Gas Engineers who realise that their consumers demand convenience equal to that provided by electricity.

Gas for domestic lighting purposes is by no means a "dead letter" since the advent of Newbridge Switches.

Newbridge Gas Fire Switches (with improved electro-catalytic ignition) are ideal for gas fire control. They eliminate matches, noisy ignition and stooping.

MODERN GAS APPLIANCES

All Newbridge Gas Appliances are of the highest quality throughout, embodying sound but distinctive engineering practice.

The continued expansion of our business is proof of the esteem in which Newbridge Controllers, Gas Switches and other products are held by members of the Gas Industry.

It is our constant aim to *Improve the Product* by a rigid attention to excellence of quality and systematic research and invention.

TYPE 3A/UNI Gas Controller.
15 or 40/42 day run.

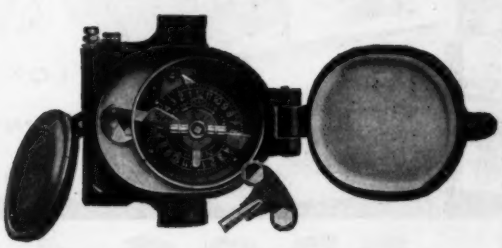
The finest controller extant for use in ordinary "square" lanterns. Now available, as an alternative, with improved form of electro catalytic ignition.

We are Exhibiting
PUBLIC WORKS
ROADS and TRANSPORT
EXHIBITION
NOVEMBER-
1933

Public lighting Controllers

We are proud of the fact that Newbridge controllers enjoy the *Largest Sale in the World*, but we are prouder of the quality and value embodied in these productions which are responsible for their commercial success.

A full range of models is available for all purposes.



Type 15/3A Gas Controller.
15 day run

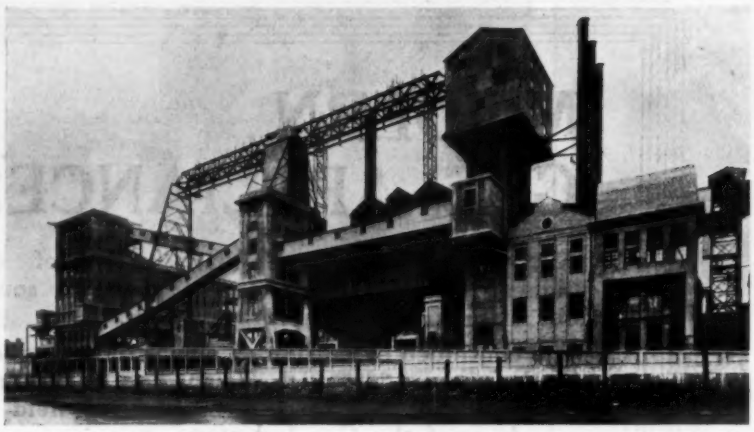
Quick lighting and extinguishing.
For suspension or upright harp lamps.
Clockwork movement instantly detachable.
Cast iron (aluminium to order) weatherproof outer cases, with indestructible cork lined joint.

The HORSTMANN GEAR Co., Ltd.

NEWBRIDGE WORKS, BATH

Telephone: Weston, Bath 7241/2. **Telegrams: Horstmann, Bath**

RECONSTRUCTION BRENTFORD GAS STATION IN REINFORCED CONCRETE



For GAS LIGHT & COKE CO. T. HARDIE, Esq., M. Inst. C. E., Engineer.

6,000 Ton Coke Storage Bunker.
Lift House.
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River Wall.
Elevated Yard and Roadway.

CONCRETE PILING LIMITED

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GAS CHEMICAL AND GENERAL ENGINEERS.

PLANT DESIGNED & BUILT FOR LASTING SERVICE.

HEAD OFFICE AND WORKS KEIGHLEY.
PHONE KEIGHLEY 2787&8.
WIRE CLAPHAM BROS. KEIGHLEY.

ALSO AT-
LONDON.
BIRMINGHAM.
AND PAISLEY.

CLAPHAM BROS. LTD

KEIGHLEY YORKSHIRE.

MAKERS OF GASWORKS EQUIPMENT SINCE 1837.

REDUCE
YOUR
MAINTENANCE
CHARGES

BY INSTALLING GOODS
OF OUR MANUFACTURE
SUCH AS:—

GAS MANTLES

WORKS
VERITAS MANTLE WORKS,
WANDSWORTH, LONDON, S.W.

BURNERS & ACCESSORIES

WORKS
VERITAS-EFESCA WORKS,
BIRMINGHAM.

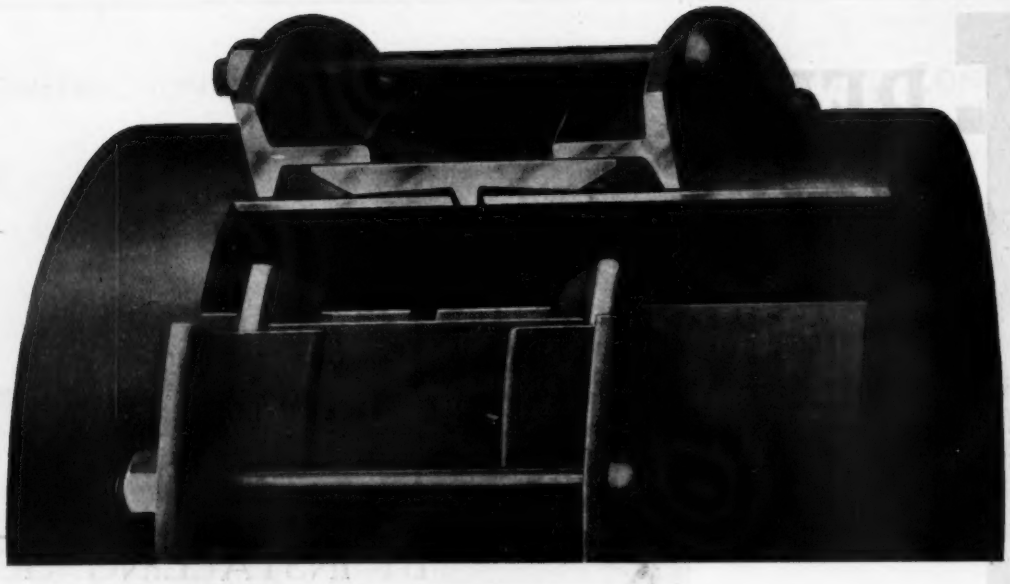
COOKERS & FIRES

FOUNDRY
RAINHILL, LIVERPOOL.

THE
"VERITAS" AUTOMATIC AIR-SCREEN BURNER
REQUIRES ONLY ONE SIMPLIFIED ADJUSTMENT
"FIT AND FORGET."

WHEN IN THE MARKET FOR
GAS LIGHTING, HEATING, AND COOKING APPLIANCES
PLEASE ASK FOR SAMPLES & PRICES FROM

FALK, STADELMANN & CO., LTD.,
83-93 FARRINGDON ROAD, LONDON, E.C.1
GLASGOW, MANCHESTER, BIRMINGHAM, DUBLIN, NEWCASTLE-ON-TYNE, CARDIFF, LEEDS, LIVERPOOL, SWANSEA.



THE JOHNSON COUPLING FOR PLAIN END PIPES

SPECIAL FEATURES

Provides flexibility, averaging 5°.

Allows for subsidence, for movement of the soil, and for expansion and contraction.

Eliminates closing lengths, expansion joints and long radius bends.

Is easily fitted by unskilled labour.

Reduces freight and laying time and costs.

25 YEARS MINISTRY OF HEALTH LOAN PERIOD.

STEWARTS AND LLOYDS LTD

GLASGOW + BIRMINGHAM + LONDON

Peebles

PATENT

STATION and DISTRICT GOVERNORS

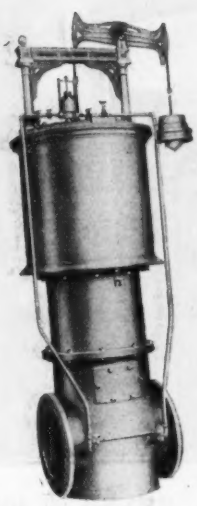


FIG. 35a
PRESSURE LOADING

Fig. 35a shows governor for Pressure loading by using the Inlet Gas Pressure. Any pressure dealt with. A Deep seal is not required.

Other Types:

Self Loading
Water Loading
Weight Loading.

We are the original Patentees of Pressure Loading.

MERCURIAL and DIAPHRAGM PRESSURE GOVERNORS for DISTRICT WORK

for High and Low Pressures. DOUBLE BALANCED VALVES quickly removed for cleaning without disturbing joints. For Weight, Air, or Clock Loading.

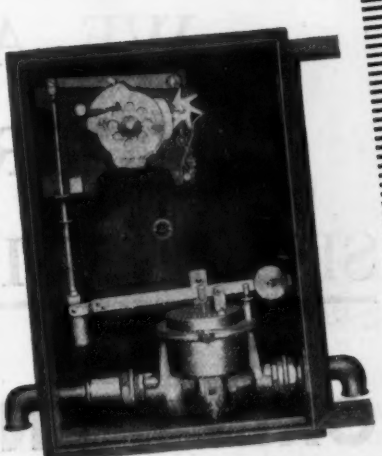
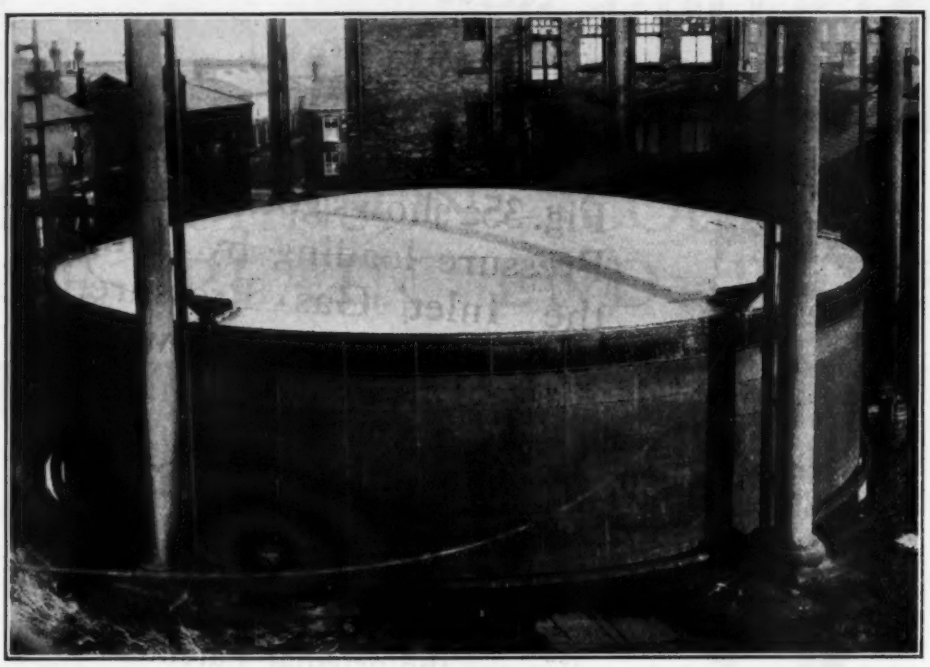


FIG. 49
CLOCK FOR AUTOMATIC TIME LOADING

PEEBLES & CO. LTD.
Tay Works
Bonnington
EDINBURGH

E.L.H.

GASHOLDER REPAIRS
BY
ELECTRIC WELDING



Photograph of 60-ft. Gasholder Welded Crown Sheets. Old Sheets cut off and New Crown completed in 14 Days WITH WATER IN TANK.

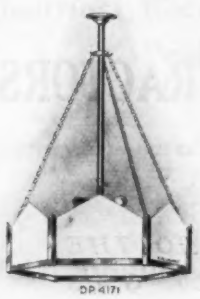
WE ARE THE ONLY
BRITISH FIRM
SPECIALISING IN THIS WORK

OXLEY ENGINEERING Co., LTD.
LEEDS

Telegrams: OXBROS, LEEDS **Telephones: 27468.9**

"HAILWARE" is "BESTWARE"!

"How I long to be kissed by that guy!
But he's slow!" sighed Miss Modern,
"and shy.
After croquet we'll go
To some night club or show,
'Neath 'Hailware,' to my arms he
will fly!"



Sole Makers—

HAILWOOD & ACKROYD, LTD.,
MORLEY, Nr. LEEDS.

Branches and Showrooms:—
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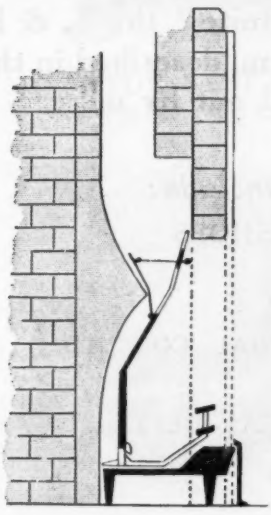
314½, ST. VINCENT STREET, GLASGOW, C. 3.
CARLTON HOUSE, 28, HIGH STREET, BIRMINGHAM, 4.

Ulster Agents:—MESSRS. BELL & HULL,
17, COLLEGE STREET, BELFAST.

94

A NEW COKE FIRE FOR 20/- ONLY



THE L.W.C. FIREBACK
(Patent applied for)

A patent attachment which can be fitted in 30 seconds to most ordinary fireplaces without alteration, whereby the fire is given an induced draught, thus enabling coke to be burnt as a bright open fire. It is fitted with a damper to regulate the fire, and it lights up very quickly either with wood and paper or a gas poker. Liberal discount to Gas Companies.

THE LONDON WARMING CO., LTD., 2, Percy Street, London, W.1

Extract from report of Research Committee findings, "Gas Journal," Nov., 1932, on Refractory Materials.

"While some improvement was obtained in a number of instances the experiments do not permit the recommendation of any cement mixture as being generally capable of fully successful application in paste form to a hot retort surface."

1933—
The New "E-B Patch"

"Stickability" over the full range of temperatures from cold to 1630°C., without possibility of injury to the Retort, as it contains no flux. It is also capable of successful application to hot surfaces in paste form with either paddle or "Gun."

Keep your retorts bottle-tight with the E.B. Gun and the E.B. Patch, and increase carbonising efficiency.
Write for full particulars.

E B REFRACTORY CEMENT Co Ltd
147, CORPORATION ST., BIRMINGHAM.

E. FOSTER & CO.
21 JOHN STREET,
ADELPHI, LONDON, W.C.2

COAL CONTRACTORS

SUPPLIERS TO THE PRINCIPAL GAS COMPANIES, RAILWAYS AND GENERAL PUBLIC UTILITY UNDERTAKINGS

Telegrams: "Efos, Rand, London."
Telephone: Temple Bar 6361 (5 lines).

GUNITE

The Contract for Reconditioning in Reinforced "Gunite" the E. & F. Purifier Buildings, Windsor Street Works, Birmingham, described in the "Gas Journal" for November 1, was carried out by us.

Other similar Contracts executed by us include:

RECONDITIONING MECHANICAL WORKSHOPS
BECKTON, GAS LIGHT & COKE CO.

RECONDITIONING COAL BUNKER
VICTORIA WORKS, EBBW VALE STEEL, IRON & COAL CO., LTD.

RECONDITIONING ASH BUNKER
LINACRE WORKS, LIVERPOOL CORPORATION GAS DEPT.

RECONDITIONING COAL BUNKER
NUNNERY COLLIERIES

RECONDITIONING COKE BUNKER
BRADFORD ROAD WORKS, MANCHESTER CORPORATION GAS DEPT.

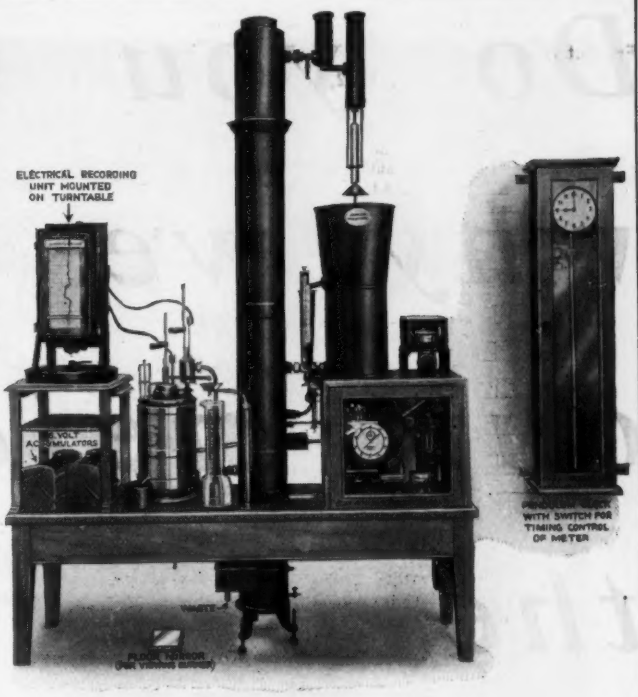
THE "CEMENT-GUN" CO., LTD.
53, VICTORIA STREET, LONDON, S.W.1

FAIRWEATHER Recording Calorimeter

Electrical Recording Equipment.
,, Positive Meter Rate Control.

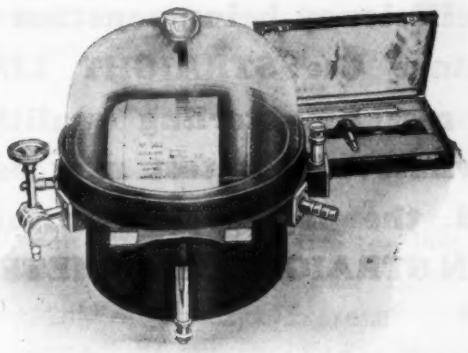
Battery operated. Electrical mains supply NOT required.

Outstandingly reliable & efficient.
An essential unit for every modern Gas Works—large or small.



HYDE TEST METER
Fitted with Revolution Counter if desired

BOYS CALORIMETER
showing Lupton Temperature Regulator attached



BOYS BELL METER
Fitted with Revolution Counter if desired

All in accordance with latest notification of Gas Referees.

Unrivalled British Workmanship and Materials.

SCIENTIFIC & PROJECTIONS LTD.

5, CRAWFORD PASSAGE, FARRINGDON ROAD, LONDON, E.C. 1. 'Phone: Clerkenwell 0156-0157

Do you know why we call our meter the "Straight Line"

It is a bold claim to make, but nevertheless it is true that the Wilson Straight Line Meter shows a loss of pressure no greater than that absorbed by a ten-foot STRAIGHT LINE of pipe, equal to the size of the meter inlet. And if the efficiency of the meter is measured by a graph, that too would result in a STRAIGHT LINE — its efficiency being constant at all loads. Since the STRAIGHT LINE appears to express the sterling qualities of this meter—whatever the test may be—we have adopted the logical course and called it the WILSON STRAIGHT LINE METER.

GEO. WILSON GAS METERS LTD.

COVENTRY, LONDON, MANCHESTER AND BLACKPOOL

One of the life-size displays designed for showroom or window use in conjunction with actual standard models of the

RADIANT PANEL

GAS HEATER

¼ and ⅛ size Displays, complete with true-to-scale working model heaters, are also available. These make interesting Counter Shows, and provide a point of contact with all showroom visitors.

May we Co-operate with you?

Another call please ... no I'm not cold .... you should have one of these RADIANT PANEL GAS HEATERS installed.
150 YEARS REPUTATION STANDS BEHIND THIS
FLAVEL
PRODUCTION

THESE displays enable you to link up with the NEATER HEATING Press Advertising (in which Miss Radiant Panel is starring). Papers used include "Daily Mail," "Sunday Express," "Punch," "Tatler," "Good Housekeeping," "Ideal Home," "Country Life," "Homes and Gardens," etc. We would also be pleased to co-operate with you by advertising in your local newspaper on a mutually agreeable basis. May we submit suggestions for approval?

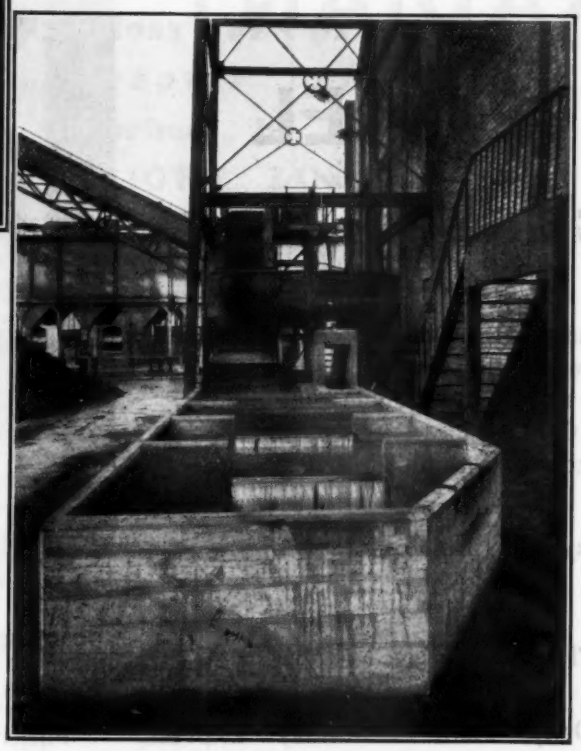
SIDNEY FLAVEL & Co. Ltd., Stovemakers since 1777 LEAMINGTON

When in London call and see the heaters working at THE WELBECK STREET FIREPLACE GALLERIES, a permanent exhibition consisting of eight galleries devoted to Fireplaces and Stoves specially selected for people of discernment. You are cordially invited to inspect 38, WELBECK STREET, LONDON, W. 1.

Gasworks Plant by GIBBONS = = =

Retort House Buildings • Complete Carbonising Plants • Vertical and Horizontal Installations • Charging and Discharging Machines (Guest-Gibbons Patent) • Retort and Furnace Fittings • Elevators, Hoppers, and Conveying Machinery

Le Fleurve Coke Conveyor, Installed at the Rochester Works of the Rochester, Chatham, & Gillingham Gas Co.



"GIBBONS-KOGAG" COKE OVEN PLANT

GIBBONS BROS., LTD.,

DUDLEY, WORCS.

AND AT LONDON, BRISTOL, AND DARLINGTON.

Specialists in—

GAS WORKS REFRACTORIES

GIBBONS have maintained their position as the leading suppliers of Gas Retorts and Refractories, by constant attention to the varying needs of Engineers and by supplying only reliable and thoroughly tested Products.

The Products that give SERVICE

Before deciding on renewals or new plant let us give you the benefit of our many years' experience.

We would call your attention to our

78% Siliceous material, Retorts, Blocks and Shapes,

and to our

95% Silica Segments and Blocks and Shapes

for

Horizontal and Vertical Gas Installations

and

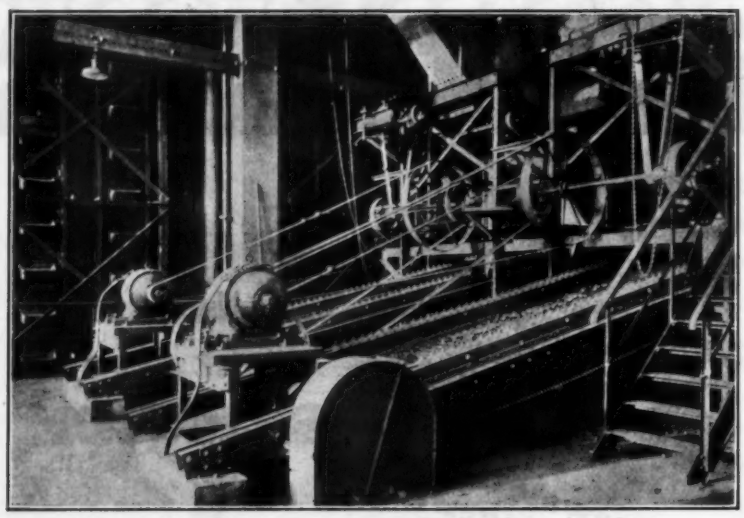
COKE OVEN PLANTS

GIBBONS (DUDLEY) LTD

Head Office:
DIBDALE WORKS, DUDLEY, Worcs.
Phone: Dudley 3141
Telegrams: "Machine, Lower Gornal"

London Office:
151/4, PALACE CHAMBERS, S.W.1
Phone: Whitehall 6417
(Adjacent Westminster Tube Station)

COKE PLANT SPECIALISTS



PARIS

THE
"RICHARD
ROISIN"
COKE SCREEN

THE
"RICHARD
ROISIN"
COKE SCREEN
GRADES
AS IT
CONVEYS

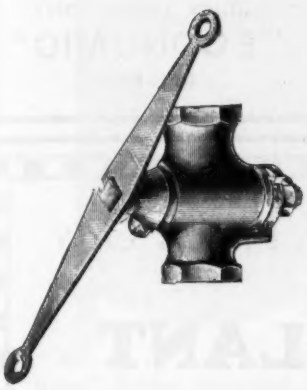
HALIFAX

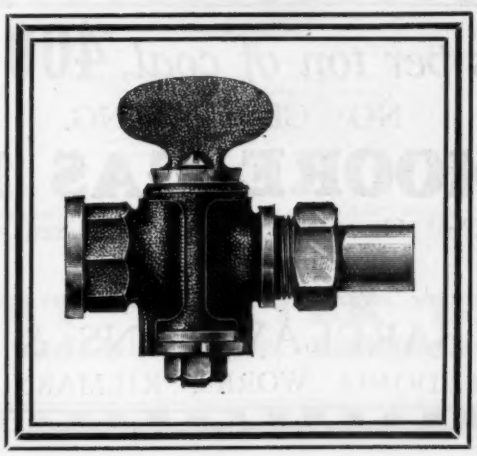
ALDRIDGE & RANKEN, LTD.

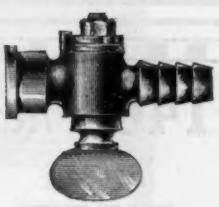
39, Victoria Street, LONDON, S.W.
Telegrams: "Motorpathy, Sowest"
Telephone: 5118 Victoria

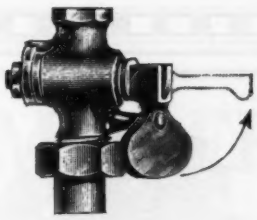
Avonbank Works, BATH
Telegrams: "Simultane, Bath"
Telephone: 2936 Bath

THE GAS COCK *YOU* SHOULD USE . . .









THE 'SPERSOM' GAS COCK

ALWAYS SOUND AND SERVICEABLE

Self-adjusting for wear.
Automatically Lubricated.
Always Turns Freely.
Always Sound.

Insist on having your Main Service, Gas Cooker and Gas Fire Cocks made in this new way.

SPERRYN
AND COMPANY
MOORSOM ST., BIRMINGHAM

TELEGRAMS: SPERRYN, BIRMINGHAM. PHONE: ASTON CROSS 5877.

NEW "Thompson"

BOILERS

EX STOCK

MOST MODERN "DISH-END" TYPE
WITH CORRUGATED SECTIONS
Standard Sizes in Stock
ALSO
WATER TUBE, CORNISH
AND VERTICAL BOILERS
SUPERHEATERS AND PIPEWORK

JOHN THOMPSON
"ECONOMIC"
BOILERS

JOHN THOMPSON (WOLVERHAMPTON) LTD.
WOLVERHAMPTON, ENG.

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140 *Therms per ton of coal,* **400** *B.Th.U. Gas*

NO CLINKERING.

THE MOORE GAS PLANT

Produces Coal Gas, Water Gas, or Mixed Gas in any desired proportions

Full particulars may be obtained from the Licencees and Manufacturers—

ANDREW BARCLAY, SONS & CO., LTD.
CALEDONIA WORKS, KILMARNOCK

The original Swiss Fittings.

Why you cannot afford NOT to use +GF+ Fittings

Every +GF+ Fitting is inspected and tested many times during the course of its manufacture.

At every stage, from the selection of the raw materials to the final soap and oil pressure test (570 lbs. per square inch for sizes up to ¾ in. dia. and 360 lbs. for fittings 1—6 in. dia.), extraordinary care is exercised in its production.

Trained eyes and scientific tests ensure that every +GF+ Fitting is a perfect one, suitable for any gas, water, oil or air service, and for continuous steam pressures up to 225 lbs. per square inch at 650° Fah.

Ask for Catalogue and terms

EVERY FITTING +GF+ GUARANTEED
Malleable Tube Fittings

8,500 sizes, ⅛ in.—6 in. Immediate delivery.

LE BAS TUBE CO., LTD.,
Dock House, Billiter Street, London, E.C. 3

E.J.H.

SMALL MECHANISMS

OF UTMOST PRECISION

Pressure Gauge Movements . . .
Escapements . . .
Wheels & Pinions

CLOCKS for RECORDING DRUMS and TIME SWITCHES (7 day to 35 day, with various times of rotation).

WATCH MANUFACTURERS SINCE 1750
Send for particulars and quotations:

ROTHERHAM & SONS, Ltd.,
COVENTRY.

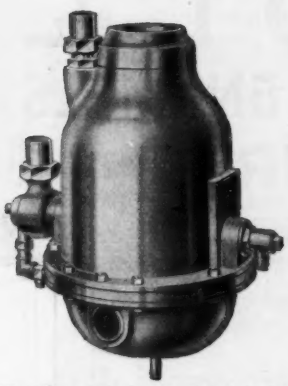
"Everything for Safety Everywhere."

SMOKE HELMETS. GAS MASKS.
BREATHING APPARATUS OF ALL PATTERNS.
OXYGEN RESUSCITATING APPARATUS.
FIRE EXTINGUISHERS. FIRST-AID OUTFITS.
SAFETY AND PROTECTIVE APPLIANCES OF ALL DESCRIPTIONS.

SIEBE, GORMAN & CO. LTD.,
WESTMINSTER BRIDGE ROAD, LONDON, S.E.1.
Telegrams: "Siebe, Lamb, London" Telephone No.: HOP 3401 (2 lines)

Outstanding "Hurro" Successes for the Coming Season

"Hurro" Mottled Enamelled Gas-Heated Wash Boiler. Made in circular or corner type from 10 to 20 gallons capacity. Also supplied with overflow for connection to bath.



The Circulator can be connected either to a new hot water installation or to an existing installation for use as an alternative in Summer to the coke boiler, which may be preferred in Winter. With such a dual system the kitchen is kept warm in Winter and cool in Summer, and hot water provided economically the whole year round.

The New "Ottawa" Water Heater. A self-contained heating unit and storage cylinder made to hold from 12 to 50 gallons and supply steaming hot water always. Gas consumption automatically controlled as water heat rises or falls. To keep a full cylinder at 140 deg. F. for an hour only 1¼ cub. ft. of gas is used.

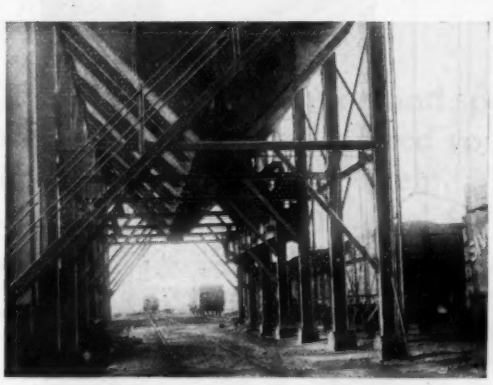
THE "HURRY" WATER HEATER CO.

Phone: Midland 6065

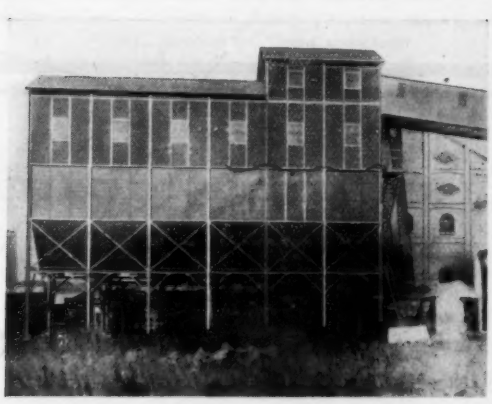
39, BROAD STREET, BIRMINGHAM 1

Telegrams: "Hurro," Birmingham.

MODERN COKE SCREENING AND GRADING PLANTS



All plants designed to include modern up-to-date units.



Our Technical Staff is at your service to prepare designs to suit local conditions.

Your enquiries are invited.

The New Conveyor Co., Ltd., Smethwick

Telephone: 0801 SMETHWICK

Near Birmingham

Telegrams: "APTITUDE, BIRMINGHAM."

NOBEL
COLOURED ENAMELS FOR GAS FIRES

The days of the Black gas fire are over.

Now a coloured fire is demanded that will harmonise with the rest of the furnishing of the room.

Nobel Heat-Resisting Enamels have been specially developed to meet the demand for brighter fires. They are made in an attractive range of colours, and a variety of novel, fancy finishes and effects can be suggested if desired. Nobel Heat-Resisting Enamels set up a higher standard of heat-resistance for gas fire finishes, for in service they retain their gloss and colour over an exceptionally long period.

No undercoats are essential for the Nobel Enamels, unless it is desired to build up an unbuffed casting, and one coat of Enamel applied by spray will give an excellent finish. No top coat of Varnish is required as the Nobel Enamels dry with an excellent gloss direct from the spray gun. ½-hour stoving at 250°F or 1 hour at 210°F is all that is required to produce a hard, durable finish which is equal in appearance and superior in heat-resistance to any other finish at present on the market.

Write for full particulars of Nobel Heat-Resisting Enamels for Gas Fires to the Industrial Division:—

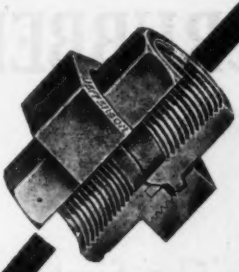
NOBEL CHEMICAL FINISHES LIMITED
(Associated with Imperial Chemical Industries Ltd.)
SLOUGH BUCKS.

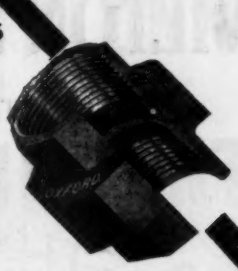
NOBEL HEAT-RESISTING ENAMELS
D.I. 115

The Jefferson Union Co.,
Lexington, Mass., U.S.A.

UNIONS OF MERIT

CONTAINING ALL THE REQUIRED FEATURES SOUGHT FOR IN PERFECT UNIONS





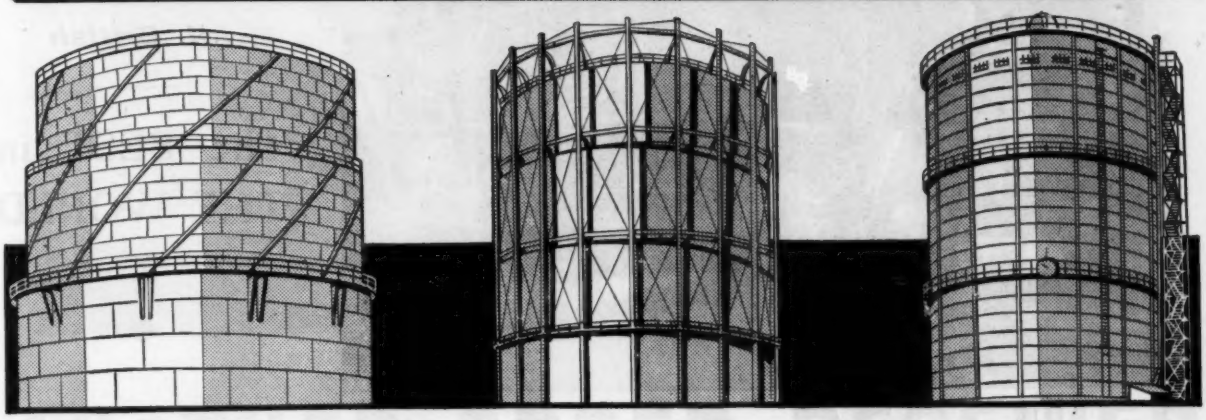
"**JEFFERSON**" pipe unions are in malleable iron, with ground ball joints having a brass seat pressed in a recess away from the corrosive action of the fluid in the pipe.

Heavy hexagon ends enable rapid tight joints, even with pipes out of alignment, unimpaired by frequent disconnecting, giving unfailing service on all pressures up to 300 lbs. per sq. inch.

"**OXFORD**" unions, for pressures up to 200 lbs., have all the essential Jefferson features, but are of somewhat lighter construction.

Distributors—
FOR GAS, STEAM, AND WATER SUPPLIES, PIPE FITTINGS, AND VALVES OF ALL TYPES.

BRITISH STEAM SPECIALTIES LTD.,
ALFRED STREET, LEICESTER



Gasholders of all types

IT is scarcely possibe to decide upon the most suitable type of Holder without a thorough investigation of all conditions.

If first hand information and specialized knowledge are required you will find Piggotts ready to help. They are manufacturers of Spiral Guided, Column Guided and Klonne Waterless Holders, and their services are at your disposal.

The HORSELEY
BRIDGE & ENGINEERING CO., LTD.
incorporating
THOMAS PIGGOTT & CO., LTD.
HORSELEY WORKS, TIPTON, STAFFS.
London Office: 22 Carlisle Place (Victoria Street), S.W.1
Works: Birmingham, Tipton, and Cardiff

THE "RELIABLE" STEAM PUMP

for TAR and all THICK FLUIDS.

Also supplied with STEAM JACKETED PUMP ENDS.

Write for No. 8 Catalogue.

Telegrams: "EVANS, WOLVERHAMPTON."
National Telephone Nos. 20864 and 20865.

London Office:
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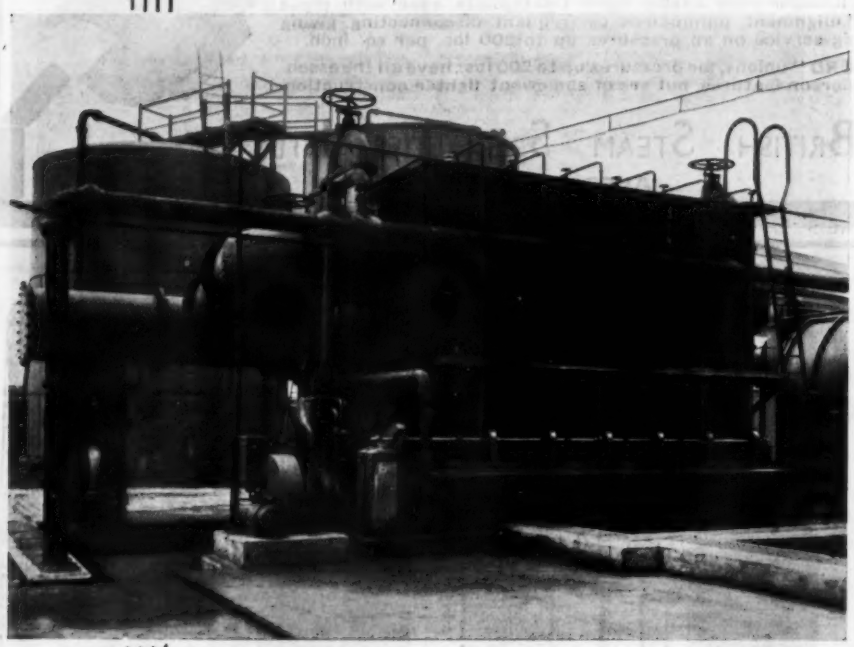
Telephone: HOLBORN 1091
Telegrams: "DRYOSBO, WESTCENT, LONDON."

JOSEPH EVANS & SONS
(WOLVERHAMPTON), LTD.,
Culwell Works, WOLVERHAMPTON.

WILTON'S STATIC WASHER-SCRUBBER

THE ORIGINAL PATENTEES OF THIS TYPE



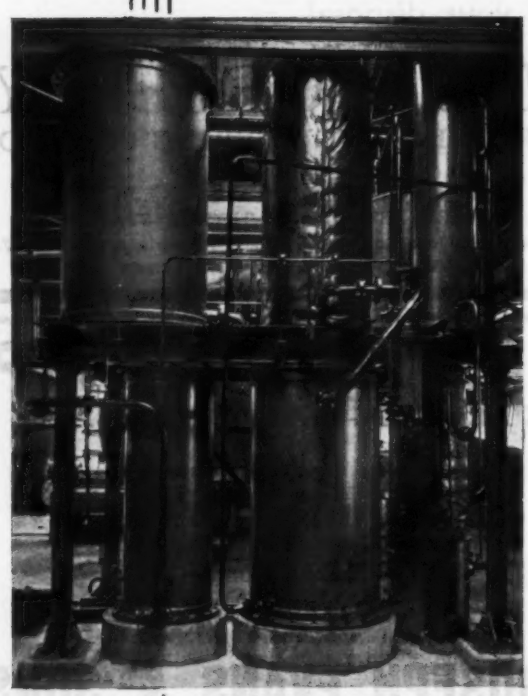
The first in ENGLAND

All British

The BEST in THE WORLD

●

25 INSTALLATIONS
all sizes, all duties, including
BENZOLE RECOVERY



BENZOLE RECOVERY UNIT
giving 170 galls. per day
75/80% Benzole.

PLANTS UNDER CONSTRUCTION AT

Yorktown & Camberley Gas Co.
The County Borough of Warrington Gas Dept.
Watford & St. Albans Gas Co. (Watford Station).
Liverpool Gas Co. (Garston Works).

●

The highest product without loss in the naphthalene fraction.

Automatic. Compact. Thermostatic controls.

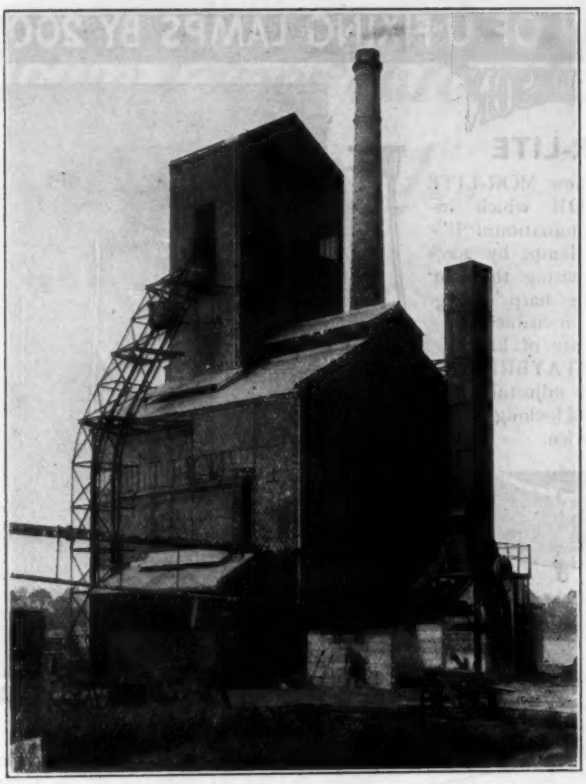
Wiltons have built over 50 installations of Crude Benzole or Rectification Plants since 1914.

●

The Chemical Engineering & Wilton's Patent Furnace Co., Ltd.

76, VICTORIA STREET, LONDON, S.W. 1

Telegrams: "Evaporator, Phone, London." **Telephone**: Victoria 2417



JENKINS KLÖNNE INTERMITTENT VERTICAL CHAMBER OVENS

ANOTHER ORDER RECEIVED

THE BRITISH GAS LIGHT CO. have just placed an order with us for their HOLYWELL WORKS for an installation to carbonize approximately 16 tons of coal per day.

PATENT BOTTOM GAS OFFTAKES

NO SEALS. NO PRESSURE IN CHAMBER. LESS LEAKAGE AND NO TROUBLE

DELAYED COMBUSTION HEATING

BETTER AND EASIER CONTROL OF HEATS THROUGHOUT LENGTH AND BREADTH OF CHAMBER

ACTUAL AND SOLE MANUFACTURERS

IN GT. BRITAIN AND FOR THE COLONIES

W. J. JENKINS & CO., LTD.

RETFORD, NOTTS.

TELEPHONE: 131 & 132 RETFORD
TELEGRAPHIC ADDRESS: "JENKINS, RETFORD"

LONDON OFFICE: **17, VICTORIA STREET, S.W.1**
TELEPHONE: **VICTORIA 5981**

INCREASES THE ILLUMINATION OF "U"-FIXING LAMPS BY 200%

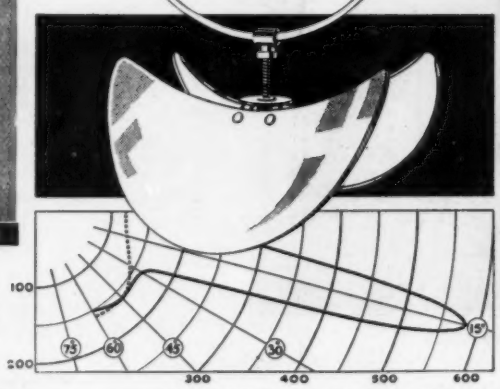
WITHOUT MOR-LITE REFLECTOR

A "U"-fixing lamp, without a MOR-LITE Reflector can only illuminate the smaller area within the dotted line shown on the graph chart

"PARKINSON"

MOR-LITE

Here is a new MOR-LITE REFLECTOR which increases the illumination of "U"-fixing street lamps by 200% without increasing the cost of gas. The harp fitting is almost invisible and the wings are of highly polished STAYBRITE steel with adjustable clip and locking device.



.....WITHOUT MOR-LITE REFLECTOR
———WITH MOR-LITE REFLECTOR.

GRAPH SHOWING POLAR CURVE COMPARISONS FOR TWO LIGHT LAMP

WITH MOR-LITE REFLECTOR

A "U"-fixing lamp with a MOR-LITE Reflector gives 200% increase in illumination as shown by the black line on the graph chart of test, and without extra cost.

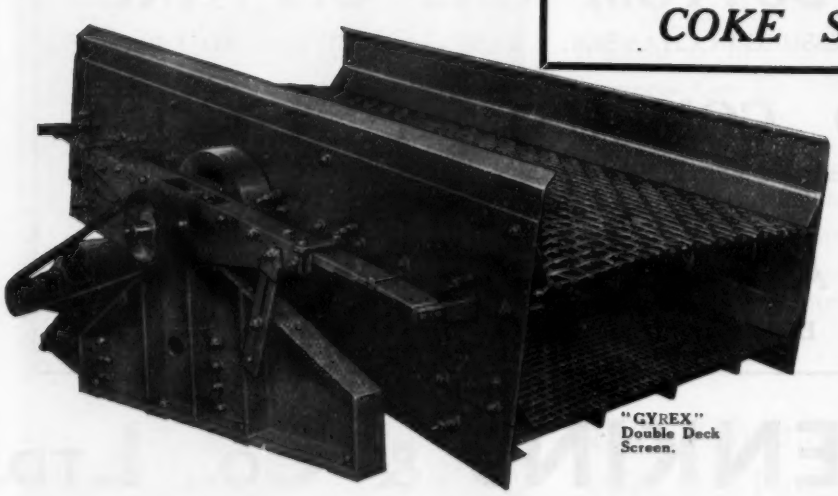
W. PARKINSON & CO.
BIRMINGHAM

LONDON & BELFAST
INCORPORATED IN PARKINSON & COWAN (GAS METERS) LTD.

FRASER & CHALMERS-ROBINS

"GYREX" SCREENS

Rapidly gaining favour for COKE SCREENING



"GYREX" Double Deck Screen.

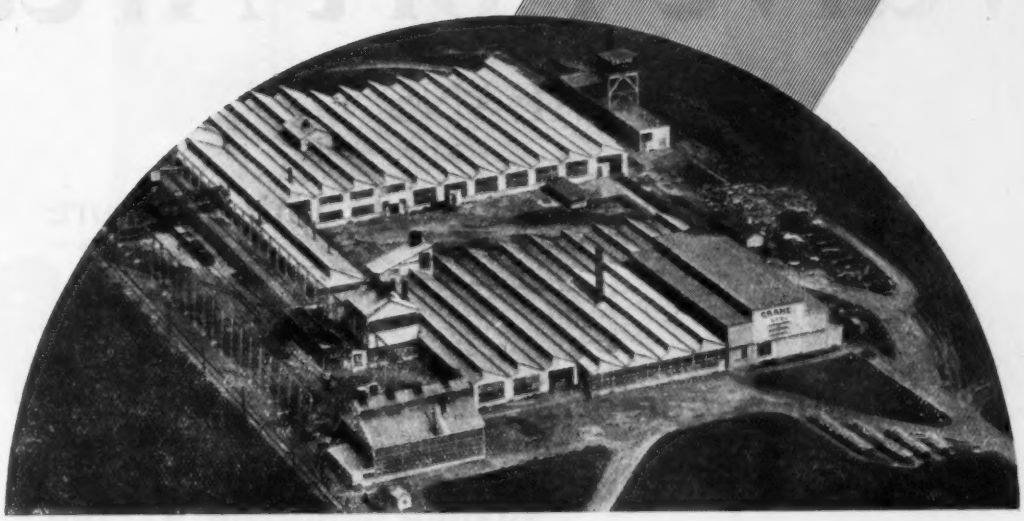
The most economical Screening Units available. Supplied in a wide range of sizes, speeds and strokes, covering every degree of screening.

The screen illustrated is handling run of oven coke at 75 tons per hour from quenching wharf, grading furnace coke above 1½", and domestic coke 1½" to 1" and 1" to 0".

Manufacturers:

FRASER & CHALMERS ENGINEERING WORKS
(Proprietors: The General Electric Co., Ltd.).
ERITH, KENT
LONDON OFFICE: MAGNET HOUSE, KINGSWAY, W.C.2.

It's the taper thread that does it!



IPSWICH WORKS

The meeting-place of High Quality and Fair Price

"Standardisation in its true sense is the union of all the best points of commodities with all the best points of production, to the end that the best commodity may be produced in sufficient quantity and at least cost to the Consumer."

FAIR PRICES

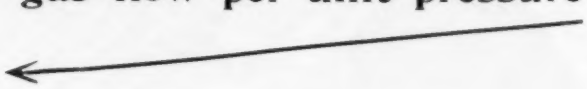
CRANE, LTD. 45/51, Leman St., London, E.1. Branches: Birmingham, Bristol, Glasgow, Manchester. Works: Ipswich

ROBINSON METERS

Maximum Valve Port Area

MEANS

1 Maximum gas flow per unit pressure



2 Minimum pressure loss

3 Punctilious Registration

These are all embodied in the

Pivoted=Plough=Valve

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Mill Lane, Old Swan, Liverpool

'Grams—Dial Liverpool 'Phones—Old Swan 36 & 634

Branches: DUBLIN, LEITH

R.G.D. 189
RANGE

BIG COOKERS

FOR

HOTELS, BOARDING HOUSES AND LARGE RESIDENCES

THIS large 'Eureka' 'New World' Gas Cooker, the R.G.D.89, is generously proportioned to provide adequate cooking facilities for large establishments. The Gas Range, R.G.D.189, is specially suitable for Hotels, Boarding Houses, etc.

R.G.D. 89
COOKER

'EUREKA' 'NEW WORLD'

R.G.D. 89. R.G.D. 189.

Cookers & Ranges,

JOHN WRIGHT & CO. LTD., BIRMINGHAM. Radiation

Humphreys & Glasgow Ltd.
Water-Gas

	Cu. Ft. Daily
Aarhus	800,000
Abertillery	500,000
Abertillery	100,000
Admiralty:	
British	4,000,000
French	1,600,000
Agram	200,000
Airdrie	431,000
Aldershot	1,400,000
Aldershot	1,000,000
Aldershot	1,316,000
Algiers	1,760,000
Alkmaar	400,000
Allenstein	200,000
Alost	700,000
Amersfoort	300,000
Amsterdam	1,000,000
Amsterdam	1,000,000
Amsterdam	2,700,000
Amsterdam	1,350,000
Antwerp	1,500,000
Antwerp	1,000,000
Antwerp	1,500,000
Antwerp	1,300,000
Arundel	215,000
Ascot	423,000
Ashford	250,000
Athens, Greece	550,000
Augsburg	425,000
Aylesbury	150,000
Aylesbury	470,000
Banbury	200,000
Banbury	200,000
Banff	125,000
Barmen	500,000
Barnsley	588,000
Barrow	300,000
Barrow	500,000
Barry	500,000
Barry	720,000
Bath	1,000,000
Bath	1,000,000
Bath	1,300,000
Bath	1,200,000
Bedford	1,000,000
Belfast	1,700,000
Belfast	4,500,000
Belfast	1,250,000
Belfast	1,250,000
Belfast	2,250,000
Benrath	125,000
Berkhampstead	259,000
Berlin:	
Charlottenb'g	2,500,000
Danziger Str.	1,600,000
Neukoelin	1,350,000
Schmargendorf	769,000
Tegel	10,095,000
Berne, Switz.	725,000
Bexhill	400,000
Bideford	258,000
Bilston	375,000
Bilston	125,000
Birmingham:	
Adderley St.	675,000
Adderley St.	850,000
Nechells	3,000,000
Nechells	3,000,000
Nechells	3,000,000
Nechells	7,650,000
Swan Village	1,500,000
Windsor St.	3,000,000
Windsor St.	3,000,000
Windsor St.	6,100,000
Bishop's Stortford	200,000
Bishop's Stortford	300,000
Bishop's Stortford	200,000
Bishop's Stortford	300,000
Blackburn	1,190,000
Blantyre	150,000
Blois	250,000
Bochum	533,000
Bognor	423,000
Bognor	500,000
Bo'ness	125,000
Bo'ness	250,000
Boulogne	340 000
Bournemouth	1,000,000
Bournemouth	500,000
Bournemouth	1,500,000
Bournemouth	1,000,000
Bournemouth	500,000
Bournemouth	1,500,000
Bournemouth	2,000,000
Bournemouth	500,000
Bournemouth	2,750,000
Bradford	1,260,000
Bremen	1,850,000
Brentwood	250,000
Brescia	1,176,000
Brest	550,000
Bridgwater	200,000
Bridlington	150,000
Bridlington	200,000
Bridlington	550,000
Brieg	100,000
Brierley Hill	250,000
Brierley Hill	425,000
Brighton	1,750,000
Brighton	1,850,000
Brighton	750,000
Brighton	2,750,000
Brighton	3,000,000
Bristol	2,000,000
Bristol	2,500,000
Bristol	825,000
Bristol	825,000
Bristol	1,500,000
Bromley	1,500,000
Bruges	800,000
Brussels:	
Anderlecht	350,000
Anderlecht	350,000
Forest	1,000,000
Forest	1,000,000
Forest	1,000,000
Forest	1,500,000
Forest	85,000
Koekelberg	1,000,000
St. Gilles	1,000,000
St. Josse	1,000,000
St. Josse	600,000
St. Josse	775,000
Ville	750,000
Brussels:	Cu. Ft. Daily
Ville	750,000
Ville	1,500,000
Ville	350,000
Bucarest	1,100,000
Buckie	164,000
Budapest	50,000
Budapest	1,750,000
Budapest	200,000
Budapest	250,000
Burnley	1,350,000
Caen	250,000
Cambridge	500,000
Cambridge	1,000,000
Cambridge	1,700,000
Cardiff	2,000,000
Cardiff	3,000,000
Cardiff	1,950,000
Cardiff	600,000
Carlisle	600,000
Carlsruhe	500,000
Carnarvon	248,000
Charleroi	1,250,000
Châteauroux	125,000
Châteauroux	125,000
Châtelet	500,000
Chester	564,000
Chesterfield	430,000
Chesterfield	90,000
Chesterton	197,000
Chichester	250,000
Chorley	300,000
Cie. de Béthune	2,145,000
Cie. des Compteurs	1,150,000
Cie. Lorraine de Ch	210,000
Cie. Minesde Roche	585,000
Clermont-Ferrand	990,000
Complete Gasification	
Coatbridge	400,000
Commercial, L'n	850,000
Commercial	850,000
Commercial	1,250,000
Commercial	2,000,000
Commercial	800,000
Commercial	2,100,000
Copenhagen	700,000
Copenhagen	2,500,000
Copenhagen	1,750,000
Copenhagen	1,200,000
Courtrai	250,000
Coventry	600,000
Coventry	600,000
Coventry	1,000,000
Coventry	1,250,000
Coventry	350,000
Cowdenbeath	420,000
Cracow	400,000
Cranleigh	188,000
Crefeld	500,000
Crewe	700,000
Crewe	800,000
Crosfield & Sons	1,500,000
Crosfield & Sons	1,500,000
Croydon	1,250,000
Croydon	625,000
Croydon	625,000
Croydon	550,000
Croydon	650,000
Croydon	1,125,000
Croydon	150,000
Croydon	3,000,000
Croydon	6,000,000
Deal	250,000
Deal	250,000
Debreczin	100,000
Derby	1,350,000
Derby	2,000,000
Deventer	150,000
Deventer	200,000
Devonport	1,600,000
Devonport	1,100,000
Doncaster	1,350,000
Dorking	150,000
Dorking	300,000
Dorking	130,000
Dover	500,000
Dover	300,000
Dublin	2,000,000
Dublin	2,000,000
Dublin	650,000
Dudley	600,000
Dundee	1,500,000
Dundee	1,650,000
Dundee	900,000
Dunedin, N.Z.	150,000
Dunedin	275,000
Durham	300,000
Dusseldorf	1,000,000
Eastbourne	1,250,000
Eastbourne	1,550,000
Edinburgh	2,000,000
Edinburgh	2,800,000
Eindhoven	1,500,000
Electro-Chimie	650,000
Enschede	282,000
Epping	500,000
Epsom	225,000
Epsom	300,000
Essen	1,400,000
Essen-Borbeck	1,400,000
Exeter	1,100,000
Exeter	1,200,000
Exmouth	376,000
Falmouth	150,000
Falmouth	200,000
Falmouth	500,000
Farnham	300,000
Faversham	200,000
Flensburg	425,000
Folkestone	1,800,000
Fond. del Pignone	164,000
Forst	300,000
Frankenthal	175,000
Fuel Research Wks.	500,000
Fuel Research Wks.	500,000
Gabionz	140,000
Gas L. & C. Co.:	
Beckton	10,000,000
Beckton	7,000,000
Beckton	3,500,000
Beckton	7,000,000
Beckton	7,000,000
Beckton	5,250,000
Beckton	4,500,000
Gas L. & C. Co.:	Cu. Ft. Daily
Beckton	3,000,000
Beckton	1,500,000
Bow Common	1,000,000
Bow Common	1,150,000
Bow Common	150,000
Brentford	1,200,000
Brentford	1,250,000
Brentford	350,000
Brentford	750,000
Brentford	6,000,000
Bromley	3,750,000
Bromley	2,250,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,000,000
Bromley	1,450,000
Bromley	1,350,000
Fulham	2,500,000
Fulham	1,700,000
Grays	250,000
Grays	400,000
Grays	725,000
Ilford	650,000
Ilford	750,000
Kensal Green	2,250,000
Kensal Green	2,250,000
Kensal Green	2,250,000
Nine Elms	2,750,000
Nine Elms	750,000
Nine Elms	1,870,000
Nine Elms	2,850,000
Shoreditch	900,000
Shoreditch	2,700,000
Shoreditch	2,725,000
Southall	2,000,000
Southall	3,000,000
Staines	600,000
Stratford	1,700,000
Stratford	850,000
Stratford	2,350,000
Stratford	2,350,000
Gelsenkirchen	525,000
Geneva	500,000
Geneva	700,000
Geneva	1,270,000
Gennevilliers	10,600,000
Gennevilliers	2,900,000
Girvan	235,000
Glasgow	3,000,000
Glasgow	2,500,000
Glasgow	2,250,000
Glossop	340,000
Gloucester	800,000
Gloucester	1,000,000
Gosport	200,000
Gosport	225,000
Göteborg	300,000
Göteborg	600,000
Göteborg	1,000,000
Graulenz	200,000
Groningen, Holland	500,000
Groningen	1,250,000
Guest Keen & P.	1,936,000
Guildford	300,000
Guildford	200,000
Guildford	350,000
Guildford	1,100,000
Guildford	150,000
Haarlem	850,000
Halifax	700,000
Hamburg	1,750,000
Hampton Court	500,000
Hampton Court	600,000
Hampton Court	1,100,000
Hanley	800,000
Hanley	800,000
Hartlepool	750,000
Hartlepool	765,000
Hastings	1,250,000
Haywards Heath	470,000
Haywards Heath	500,000
Hebden Bridge	200,000
Heidelberg	200,000
Hereford	525,000
Hertford	197,000
Hertford	244,000
Hessle	150,000
Heywood	500,000
High Wycombe	752,000
Hilversum	850,000
Hilversum	1,000,000
Hinckley	250,000
Holyhead	197,000
Hong Kong	450,000
Hong Kong	450,000
Hornsey	1,000,000
Hornsey	1,000,000
Hornsey	750,000
Hornsey	750,000
Horsham	235,000
Houillère de Lievin	2,300,000
Hull	1,500,000
Hull	1,000,000
Hull	1,600,000
Innsbruck	200,000
Ipswich	750,000
Ipswich	1,250 000
Ipswich	600,000
Jersey	564,000
Jersey	564,000
Kampen	350,000
Karlsbad	350,000
Kendal	329,000
Kidsgrove	235,000
Kiel	1,880,000
Kilmarnock	500,000
Kilmarnock	585,000
King's Lynn	197,000
King's Lynn	400,000
Kingston-on-Th.	3,400,000
Kirkintilloch	360,000
Kirkintilloch	827,000
Kolozvar	100,000
Lancaster	500,000
Langley Mill	500,000
Largs	235,000
Lausanne	250,000
Lausanne	385,000
Lausanne	970,000
Lea Bridge	350,000
Lea Bridge	350,000
Lea Bridge	400,000
Lea Bridge	1,000,000
Lea Bridge	Cu. Ft. Daily
Lea Bridge	1,500,000
Lea Bridge	1,530,000
Leamington	600,000
Leamington	525,000
Leatherhead	705,000
Leeds	1,500,000
Leeuwarden	400,000
Leicester	2,700,000
Leiden	500,000
Leiden	575,000
Leigh	350,000
Lemberg	760,000
Letchworth	362,000
Letchworth	423,000
Liége	1,000,000
Liége	750,000
Lille	860,000
Lille	1,410 000
Lincoln	500,000
Lincoln	893,000
Littlehampton	500,000
Liverpool	3,500,000
Liverpool	4,500,000
Liverpool	750,000
Liverpool	1,750,000
Liverpool	1,250,000
Liverpool	3,000,000
Liverpool	1,500,000
Liverpool	1,250,000
Liverpool	2,350,000
Liverpool	3,000,000
Liverpool	8,000,000
Long Eaton	430,000
Long Eaton	170,000
Longton	1,000,000
Louvain	800,000
Lubeck	400,000
Luton	400,000
Luton	300,000
Maastricht	200,000
Macclesfield	800,000
Magdeburg	1,400,000
Maidenhead	225,000
Maidenhead	225,000
Maidenhead	175,000
Maidenhead	175,000
Maidenhead	200,000
Maidenhead	200,000
Maidstone	500,000
Maidstone	500,000
Malines	500,000
Malines	375,000
Malmö	350,000
Malta	400,000
Manchester	3,500,000
Manchester	3,500,000
Manchester	1,500,000
Mansfield	330,000
Mansfield	493,000
Margate	960,000
Marlborough	100,000
Mayence	700,000
Melbourne	5,000,000
Merthyr Tydfil	300,000
Merthyr Tydfil	200,000
Middlesbrough	1,250,000
Middlesbrough	750,000
Middlesbrough	900,000
Middlesbrough	1,330,000
M/M. Woolston	9,000,000
Minehead	300,000
Monaco	275,000
Monaco	618,000
Monaco	618,000
Monaco	400,000
Complete Gasification	
Mons	600,000
Montevideo	1,222,000
Morecambe	333,000
Moscow	1,000,000
Munich	1,400,000
Namur	175,000
Narbonne	350,000
Nelson	400,000
Nelson	350,000
Neuchatel, Switz.	250,000
Neuss	140,000
Newbury	250,000
Newcastle	2,500,000
Newcastle, N.S.W.	500,000
Newhaven	235,000
Newport Pagnell	188,000
Nice	900,000
Nice	1,225,000
Nictheroy	250,000
Nimes	420,000
North Middlesex	200,000
North Middlesex	200,000
North Middlesex	1,000,000
North Middlesex	1,600,000
North Middlesex	800,000
Complete Gasification.	
North Middlesex	900,000
2nd Complete Gasification.	
North Sydney	500,000
North Sydney	500,000
Norwich	1,000,000
Norwich	300,000
Norwich	500,000
Norwich	1,500,000
Nottingham	1,000,000
Nottingham	1,000,000
Nuneaton	125,000
Oberhausen	175,000
Oldbury	500,000
Oldenburg	200,000
Ormskirk	170,000
Ostend	100,000
Ostend	200,000
,, Zandvoorde	700,000
Oxford	4,500,000
Palermo	968,000
Palermo	850,000
Paris:	
Clichy	4,000,000
Ivry	2,355,000
Landy	6,000,000
Landy	6,000,000
Landy	5,295,000
La Villette	4,000,000
La Villette	2,000,000
La Villette	2,000,000
Paris-Plage	125,000
Pau	550,000
Pavie	194,000
Pavie	212 000
Pembroke	240,000
Perigueux	350,000
Perth, W.A.	125,000
Perth, W.A.	1,000,000
Petone, N.Z.	200,000
Piggott & Co.	1,500,000
Plymouth	2,000,000
Poitiers	350,000
Pontypool	130,000
Port Elizabeth	400,000
Portsmouth	1,000,000
Portsmouth	2,000,000
Portsmouth	800,000
Portsmouth	2,000,000
Posen	1,150,000
Prague	140,000
Preston	1,400,000
Pwllheli	60 000
Ramsgate	430,000
Reading	1,000,000
Reading	1,000,000
Reading	600,000
Redditch	500,000
Redhill	275,000
Redhill	300,000
Redhill	1,100,000
Redhill	625,000
Reichenberg	400,000
Reval	350,000
Rhymney	175,000
Rhymney	250,000
Riddings	258,000
Ripley	120,000
Rochester	2,200,000
Rochester	2,800,000
Romford	300,000
Romford	350 000
Romford	1,200,000
Rotterdam	850,000
Rotterdam	1,500,000
Rotterdam	750,000
Rotterdam	750,000
Rotterdam	600,000
Rotterdam	2,000,000
Rotterdam	500,000
Rouiers, Belgium	250,000
Royston (Yorks.)	250,000
Rugby	1,000,000
Rugby	450,000
Rushden	425,000
Rushden	517,000
Rushden	225,000
Ryde	600,000
Ryde	600,000
Saffron Walden	235,000
St. Albans	700,000
St. Albans	580,000
St. Albans	1,500 000
St. Andrews	210,000
St. Andrews	500,000
St. Andrews	390 000
St. Gallen	225,000
St. Gallen	225,000
St. Nicolas, Belgium	250,000
Sté. Ch.Gr. Paroisse	1,320,000
Sté.Ch.Gr Paroisse	2 900,000
Sté. I. & F. de Lens	1,130,000
Sté. I. & F. de Lens	1,130,000
Sté. Kuhlmann	1.285,000
Sté. Kuhlmann	3,200,000
Sté. Kuhlmann	2,150,000
Sté. Kuhlmann	3,830 000
Sté. Tubes Meuse	545,000
San Paulo	700,000
Sarragosse	264,000
Scarborough	800,000
Scarborough	200,000
Scarborough	350,000
Scarborough	1,300,000
Scarborough	1,350,000
Seaford	200,000
Shanghai	225,000
Shanghai	225,000
Shanghai	1,600,000
Shanghai	2,200 000
Shanklin	250,000
Shanklin	400,000
Sheerness	200,000
Sheerness	180,000
Sheerness	200,000
Sheerness	220,000
Sheffield	1,530,000
Sheffield	3,000,000
,, Steel Prods.	3,000,000
Shirebrook	500,000
Shrewsbury	300,000
Shrewsbury	170,000
Sidmouth	225,000
Singapore	600,000
Sittingbourne	259 000
Southampton	800,000
Southampton	500,000
Southampton	600,000
Southampton	100,000
Southampton	1,000,000
Southampton	1,450,000
Southend	1,250,000
Southend	900,000
Southend	900,000
Southend	600,000
Southgate	400,000
Southgate	500,000
Southgate	800,000
Southgate	500,000
Southgate	1,900,000
Southport	750,000
Southport	900,000
Southport	900,000
Southport	450,000
South Shields	650,000
South Shields	1,250,000
Stafford	500,000
Stafford	750,000
Stettin	880,000
Steyning	150,000
Stirling	400,000
Stirling	970,000
Stockholm	1,500,000
Stockholm	1,750,000
Stockport	600,000
Stockport	600,000
Stockport	400,000
Stockport	400,000
Stockton	500,000
Stockton	250,000
Stourbridge	500,000
Stourbridge	500 000
Sunderland	2,250,000
Sunderland	300,000
Sunderland	475,000
Sutton	1,263,000
Sutton	625,000
Swanage	300,000
Swansea	750,000
Swansea	1,000,000
Swansea	450,000
Swansea	1,250,000
Swansea	2,000,000
Swindon	300,000
Swindon	450,000
Swindon	400,000
Sydney	1,000,000
Sydney	1 000,000
Sydney	1,000,000
Sydney	1,000 000
Sydney	8,250,000
Sydney	2,750,000
Taunton	225 000
Taunton	350,000
Tawe Valley	275,000
Teignmouth	200 000
The Hague	1,000,000
The Hague	500,000
The Hague	1,750,000
The Hague	1,500,000
The Hague	775,000
The Hague	1,500,000
The Hague	2,030,000
Tilburg	400,000
Tirlemont	120,000
Tokyo	2,000,000
Torquay	350,000
Torquay	350,000
Torquay	320,000
Tottenham	750,000
Tottenham	750,000
Tottenham	350,000
Tottenham	1,000,000
Tottenham	1,000,000
Tottenham	1,250,000
Tottenham	2,500,000
Tottenham	1,000,000
Tottenham	500,000
Tottenham	1,000,000
Toulouse	1,800,000
Toulouse	785,000
ToulouseNatl. Wks.	2,400,000
ToulouseNatl. Wks.	6,200,000
ToulouseNatl. Wks.	3 730,000
Tournai	700,000
Tours	550,000
Trowbridge	250,000
Trowbridge	150,000
Tunbridge Well	1,000,000
Tunbridge Wells	1,000,000
Tunis	175,000
Tynemouth	1,100,000
Tynemouth	1,100,000
Ulm	400,000
Union Chim.-Belge	1,977,000
Utrecht	1,000,000
Utrecht	1,000,000
Uxbridge	725,000
Uxbridge	1,000,000
Vancouver	3,800,000
Verviers	1,000,000
Vevey, Switz.	650,000
Victoria, B.C.	500,000
Vienna	6,000,000
Walsall	750,000
Walsall	375,000
Waltham	400,000
Waltham	140,000
Walton-on-Thames	970,000
Wandsbek	125,000
Wandsworth	1,800,000
Wandsworth	4,230,000
Wanganui, N.Z.	376,000
Ware	150,000
Ware	282,000
Warwick	125,000
Wasmuel	500,000
Watford	300,000
Watford	350,000
Watford	400,000
Watford	1,250,000
Wath	430,000
Weimar	100,000
Wellingborough	525,000
Wellingborough	525,000
Wellingborough	550,000
Wellington, N.Z.	350,000
Wellington	300,000
West Bromwich	550,000
Westgate	250,000
Weston-Mare	350,000
Weston-Mare	350,000
Weston-Mare	150,000
Weston-Mare	150,000
Weston-Mare	500,000
Wexford	100,000
Weymouth	400,000
Weymouth	100,000
Weymouth	658,000
Whitstable	423,000
Widnes	500,000
Wiesbaden	850,000
Wigston	250,000
Winchester	225,000
Winchester	125,000
Winchester	410,000
Winchester	325,000
Woking	400,000
Wolverhampton	1,500,000
Wolverhampton	1,000,000
Wolverhampton	250,000
Wolverhampton	400,000
Worthing	525,000
Yarmouth	500,000
Yarmouth	125,000
Yeovil	340,000
Zwolle	200,000
Zwolle	200,000
Zwolle	700,000

950 *Sets of Humphreys-Glasgow Plant have been (and are being) installed with a capacity of over* **842,000,000** *cubic ft. of Water-Gas per diem. Including the work of their American Colleagues,* **2070** *Sets have been constructed with a total* **Daily** *capacity of* **2,291,000,000** *cubic feet.*

Humglas House, Carlisle Place, London, S.W. 1.

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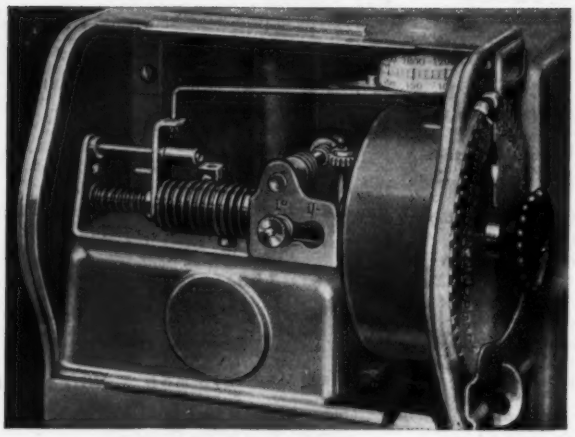

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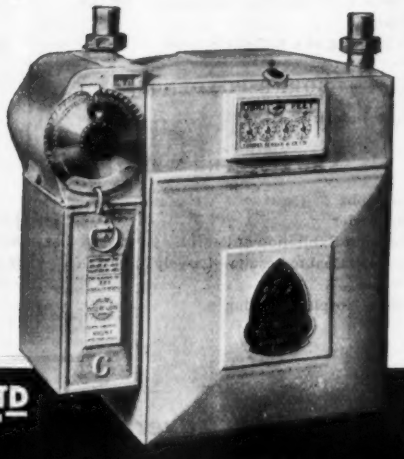

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THE GAS JOURNAL

NOVEMBER 15, 1933

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EDITORIAL NOTES

A *Purposeful Meeting*

Two very strenuous days were spent last week by those attending the Autumn Research Meeting of the Institution of Gas Engineers. Steeped in learning, research workers talked "about it and about," their only enemy being the clock. The meeting last week must be counted among the most successful held. There was steady enthusiasm from start to finish, and the attendances throughout—the Hall of the Institution of Mechanical Engineers was filled at the last session on Wednesday afternoon—must have been a source of great encouragement to the research workers, who are so unflagging in their service to the Industry. The Institution of Gas Engineers has shown prescience in placing such a high premium on research, the practical value of which is being proved all along the line.

Very appropriately these research meetings start by consideration of general education in the Industry; and few industries, we think, can have done more than the Gas Industry to help the younger members to fit themselves for life and livelihood. A decade of the Education Scheme was briefly reviewed by Sir Francis Goodenough, and the progress made during these ten years is a tribute to the sincerity and singleness of purpose of those executives of gas undertakings who have put in such a vast amount of constructive work on this vital matter. The evolution of the Education Scheme is a remarkable example of tactful, sympathetic handling. The response of the students is a measure of its strength. The danger of too-early specialization was emphasized by Dr. Long, Principal of the Westminster Technical Institute, and Col. Carr, whose comments are really an appeal to engineers and managers to consider the education of juniors still more widely and still more closely, and what Mr. Briggs had to say is much to the point. Square pegs, even in 1933, do not sit well in round holes; a flair for examinations is not alone a criterion of a man's ability to occupy a job happily and successfully; youth needs wise direction; above all, a man who has taken the trouble to become efficient and capable must find his worth translated into hard cash.

A *New Slogan*

LET us turn to the report of the work which Mr. Wood, as Research Chemist, has been doing during the past twelve months on the all-important, highly complex problem of corrosion caused by the products of combustion. Corrosion of appliances costs our Industry dear; and apart from the money spent on maintenance of apparatus there is the question of the goodwill of the consumer. We must do something, and quickly, to remedy this wastage caused by corrosion; and to our mind Dr. Hartley, in the discussion on the report, hit the nail hard on the head when he suggested a new slogan for the Industry—SULPHUR MUST GO! It is obviously not the only corrosive agent in the products of combustion of town gas, but it appears to us to be the most important. Mr. Howarth queried whether the entire removal of sulphur from gas will have such a beneficial effect as some of us may anticipate; and we agree with him that tests on sulphur-free gas should be carried out. But there is no denying that sulphur dioxide stinks; and stinks are bad for the Gas Industry. They are bad for the lighting load, and they are bad for the employment of perfectly safe appliances unconnected with a flue.

What are we going to do about it? The utilization side of the Industry should arrive at some estimate of the corrosion costs caused by sulphur in gas—we appreciate the difficulty of this, how hard it is to single out one agent of corrosion and say, this costs me so much. It is not, however, beyond the wit of the Industry to come to some approximate figure. Add to this the loss in custom resulting from the stink. Then let the utilization side tell the manufacturing side how much this total represents per 1000 c.ft. of gas. We shall be very surprised indeed if the manufacturing side cannot provide a remedy on a sound economic basis. Gas can be sent out from the works containing a negligible amount of sulphur compounds—and in this direction, by the way, we do not regard the removal of carbon bisulphide as sufficient. The average quantity of sulphur compounds in town gas to-day is about 25 grains per 100 c.ft. At Beckton gas is being sent out containing approximately 7-8 grains per 100 c.ft., and only part of the gas made is treated for total sulphur removal. At the meeting insufficient emphasis was laid on the fact that the manufacturing side is alive to the situation and has undertaken a great deal of research.

Again, sulphur removal from town gas will add incentive to the purchase of washed coals; and washing does remove inorganic sulphur (pyrites), though it cannot, of course, deal with organic sulphur. Yes, there is much to be said for Dr. Hartley's slogan.

Chemists and Collaboration

IT is only a matter of a few years since the problem of disposing of effluents assumed alarming proportions; gas undertakings were really up against it. No more apt example of the practical worth of research could be afforded than the work of the Effluents and Ammonia Committee. This Committee has—and this is no exaggeration—transformed the whole situation; and the thanks of the Gas Industry generally are due to the Research Chemists who have been engaged in the investigations. These chemists are unusually gifted for research of the nature. Dr. Parker and Dr. Monkhouse have left the Industry, but their interest in the Committee's work is unimpaired. We now have Dr. Key, and he has justly earned the praise given so freely at the meeting. It is not that difficulties no longer exist in regard to the disposal of liquor and effluents, but that knowledge is now available which, with the collaboration of the sewage authorities, can smooth away these difficulties. Never

was there better proof of the efficiency of co operation. If any undertaking is in doubt, said Mr. Botley, it shou'd communicate with the Committee, and the rest will be comparatively easy.

The comments of Mr. Parrish during the discussion deserve underlining. He reiterated his view—and he has no two opinions on the matter—that the solution of the ammonia problem lies in the treatment of concentrated liquor at central works operating on a large scale, this treatment not necessarily to imply the working up of the liquor into ammonium sulphate. This matter of centralization was dealt with from another angle by Dr. E. W. Smith, who thinks (and there are many who agree with this) that the Gas Industry " missed the boat " a few years ago in not facing the sulphuric acid situation and the manufacture of sulphate economically as an Industry. He wonders what will happen in regard to ammonium bicarbonate. How will its manufacture be regarded by a selling organization which is non-controlled by the Industry? His argument is simply that the carbonizing industries must play the major part in selling their ammoniacal products. Once again, what about it?

Why Dr. Smith should have chosen the discussion on the report of the Ammonia and Liquor Effluents Committee as a suitable opportunity for bringing-in that very sore point of why excellent chemists, so necessary to the Industry's welfare, should be debarred from corporate membership of the Institution, we cannot say. The whole problem of effluents—or at any rate 99% of it—is a chemical one, and it is but natural that chemists should discuss it. After all, the meeting was a research meeting of the Institution. But we are glad that, once again, the subject was raised in public. Mr. Tarratt expressed himself as being in full sympathy with the idea of admitting chemists with suitable qualifications. The terms of the Royal Charter of the Institution impose an obstacle, but an endeavour will, he said, be made to surmount it. We certainly hope that means will speedily be found for remedying an unsatisfactory situation. There exist many so-called chemists who have suitable qualifications for voting power in the Gas Industry, and whose services are being used to benefit the Industry.

Saving Money

For the past three years it has been the practice to discuss at the autumn research meeting not only research reports of the various Committees of the Institution, but also " private communications." These private communications have been of first-rate interest, those presented last week maintaining the high standard one has come to expect. Mr. Clucas, of the Leeds Gas Department, dealt with the leakage of coal gas from horizontal retorts, and Mr. Hodsman, of Leeds University, with the behaviour of cokes in the open firegrate. Of this, more anon. It was shown by Mr. Clucas, as a result of experiments at Leeds, what a great deal of money can be saved by employing certain precautions in the operation of horizontal retorts; and at this stage we would remind readers of the great part that the Leeds Gas Department has played, and is continuing to play, in the research work of the Institution. Mr. Shapley, who was largely responsible for the inauguration of these autumn research meetings, is keen on research; it saves him money. He explained last week how his Department has benefited by the work of Mr. Clucas and his colleagues—how it was made economically possible to prolong the working life of horizontal retorts.

Briefly, the points to watch to minimize leakage from horizontal retorts are to maintain a minimum pressure gradient between the inner surfaces and outer walls of the retort, which implies among other things careful charging with due regard to the characteristics of the coal being carbonized; and to ensure a film of carbon on the inner surfaces, and deposit of carbon in any small holes or cracks. The use of naphthalene after the scurfing operation, which is the practice, as mentioned by Mr. Mead, at the Beckton Works of the Gas Light and Coke Company, is worthy of special note in this connection.

Methods of saving money by reducing the flaking of vertical retorts were discussed in connection with the report of the Refractory Materials Sub-Committee. The introduction of this report was one of the brightest features of the meeting. Mr. Green is always entertaining, and he excelled himself last week. It is apparent that the flaking of retorts depends largely on the scurfing operation. Every possible care should be exercised to avoid local heating and the setting-up of unnecessary strains due to the unequal expansion of the refractory and the scurf. The importance of paying close attention to the scurfing operation was emphasized by Mr. Carder, who gave figures relating to the working of an installation of intermittent vertical chamber ovens. Mr. Carder does not regard high-combustion chamber temperatures as being, *per se*, a cause of flaking. Mr. Mitchell, of Leicester, with the aid of a blackboard, urged all present to have as their first consideration the careful regulation of temperature throughout the entire length of a continuous vertical retort. The significance of his remarks will be brought home by the diagram which accompanies them in our report of the discussion on later pages of this " Journal."

Smokeless Fuel

As we have said, the Hall of the Institution of Mechanical Engineers was well filled when, at the last session of the meeting, Mr. Hodsman rose to introduce the communication by himself and Dr. Lloyd and Mr. Bell on the behaviour of cokes in the open firegrate. The preparation and sale of a smokeless fuel suitable in all respects for the open firegrate must be tackled by our Industry, and this in no half-hearted fashion. The influential backing of low-temperature carbonization schemes, the fact that the coke oven industry is fully capable of modifying their process to make, from washed slacks, domestic smokeless fuel of high quality, render it essential for the Gas Industry to accelerate developments itself, and not to await developments from outside sources.

The discussion on Mr. Hodsman's contribution proved extremely fruitful, and should be read by everyone in our Industry. It was a miscellany of strong views. The contribution itself sums up very neatly existing knowledge of the requirements of coke for the domestic grate, the influence of ash, moisture, bulk density, reactivity, and so on. It outlines, too, a new technique for rendering gas cokes readily ignitable by spraying them with coal dust, using tar as the fixing medium—a method which formed the subject of an article from the pen of Mr. Hodsman in the " Journal " for March 22 of this year. There is no need for us to enter into any detail about this here, but it would appear to be a process of much promise.

Mr. Hodsman having argued that high-temperature cokes are better value for money than low-temperature cokes, suggests that more attention should be directed to the design of grates for the fuel, rather than the attempt to fit the fuel to the grate; and he believes that all solid fuel grates should have gas ignition. (After all, in these enlightened days one would not buy a motor-car without a self-starter.) No, says Mr. Gibson, gas ignition is a confession of failure. Make a coke which can be readily ignited, and make it by high-temperature carbonization. Mr. Gibson is doing this at Liverpool, and the growing popularity of his special domestic coke shows that he is on the right lines. Another " No " to the gas ignition device was voiced by Mr. A. F. Dufton, whose observations may be summed up thus: Use my grate; employ gas coke; light the coke with wood and paper—and be happy. This particular grate was described and illustrated in the " Journal " for Nov. 11, 1931, and it has been used by Mr. Dufton's household, burning gas coke with every satisfaction, for over six years.

Gas engineers who sell water instead of coke are doing the Industry immense harm. This was the gist of Mr. Holton's contribution to the discussion. At Manchester his domestic coke contains never more than 1½% of water, and his customers are as satisfied with the coke as he is with the returns in £ s. d., and the knowledge that he has a stable market. We shall never make a success of the coke market if the coke, when placed on the fire, disintegrates and deposits itself in small pieces on chairs and carpets. This is a point of the utmost im-

portance. A domestic smokeless fuel must be silent in burning and free from " fliers." In this regard, Mr. Firth, of Leeds, had much of interest to impart. As a result of experiments he has come to the conclusion that silent burning and absence of " fliers " depend, not on the moisture content of the coke, but on the procedure adopted in cooling the coke. Shock quenching by water makes a noisy coke prone to " fliers." Controlled cooling by inert gases produces a silent burning, perfectly safe smokeless fuel.

The foregoing is an indication of the value of the discussion; it will surely whet mental appetites for more—and more will be found on later pages.

Finally, a word on the conduct of the meeting. All were agreed at the close that Mr. Tarratt had proved himself a splendid Chairman. Under his able guidance the whole proceedings went with a swing.

A Thriving Society

ONE of the gratifying features of last week's meeting of the Society of British Gas Industries was the statement by the Chairman, Mr. H. E. Bennet, that the membership is steadily growing—seven new firms having joined this year. No doubt there is plenty of room for realization of the hope expressed that all will do their best to introduce new members, and thus still further strengthen an organization which has become an essential part of our Industry.

There is no need here to deal in detail with the kind or quality of the work done by the Society. Attention may, however, be drawn to the reference at the meeting to the interest of the members in the Gas Industries Section of the British Industries Fair, Birmingham, " which will again be arranged for the 1934 Fair, but on a much larger scale." The Gas Industry Inquiry Bureau, provided by the Heavy Industries Section of the Society in conjunction with the British Commercial Gas Association, will, said the Chairman, once more form a prominent central feature in the Section. Among other things, it will be noted, the Society will be taking an active part in the International Congress on Chemical Engineering, which is to be held in London in 1935.

With regard to the business of the meeting, Mr. Bennet's description of some of the high spots of the recent Institution of Gas Engineers' tour in Canada and the United States proved attractive, and was heartily endorsed by members of the party who spoke subsequently. Specially emphatic was this endorsement with reference to the statement in the addresses that both Canada and the United States fully lived up to their reputation for hospitality during the visit. The cordiality of our reception everywhere was, indeed, the " highest spot " in a tour which included many wonderful hours. But, as pointed out by the Chairman, we were fortunate also in other directions; for in Mr. Tarratt we had an ideal leader, while the organizing work of Mr. Alexander and the Canadian Pacific Railway left nothing whatever to be desired.

Tar Grows in Favour

" BRITISH Road Tar is enhancing its reputation, and is making steady progress in public favour." There are doubtless a number of reasons why Sir David Milne-Watson was in a position last Wednesday to make this simple and straightforward announcement, but the strongest reasons of all must be found, as he said, in the facts of combined effort in the pursuance of a high objective and the weight given to the British Road Tar Association's representations. Though young in years—it was only the sixth Annual Meeting which Sir David was addressing—the Association has accomplished a great deal by hard work and constant vigilance. In spite of the fact that it is less than a quarter of a century since the first specifications for road tar were issued by the Road Board, a large proportion of the 2 million tons of tar which are produced annually from the carbonization of coal is now used on the roads.

And the future is bright. Compared with ten years ago, nearly double the quantity of tar is now used on the roads, and, as we know, this success has been achieved in the face of the keenest competition from a product of foreign origin. Quoting from Sir David's address, " British tar has to-day made it possible to travel in safety, immune from the danger of serious skidding accidents, for thousands of miles in Great Britain, on roads that are British throughout—the stone from British quarries, the slag from British furnaces, the tar derived from the carbonization of British coal being the paramount materials. As the result of experience and enterprise, British tar is now meeting every requirement of the road engineer, and is available throughout the country in sufficient quantities to meet all the demands that may be made upon it." This constitutes a responsibility as well as a privilege—a responsibility for the supply at all times of an efficient and constant article—and we are sure that the road users will not be let down in respect of the meeting of their requirements, just as the gas consumers are not let down in respect of the meeting of theirs.

PERSONAL

Alderman JOHN HENRY LLOYD has resigned his position as Chairman of the Birmingham Corporation Gas Committee, which he has held continuously with great distinction since 1919, and for three years previously from 1898 to 1901. He is the oldest member of the Birmingham City Council, a former Lord Mayor, and a Freeman of the City. He will continue to be a member of the Gas Committee. The Alderman is on the Directorate of Stewarts & Lloyds, Ltd. The new Chairman of the Gas Committee is Councillor R. H. HUME.

* * *

Mr. J. R. W. ALEXANDER, Secretary of the Institution of Gas Engineers, has been appointed a Trustee of the Ardingly College Mission at Poplar, in the East End of London, by the Executors of the late Mr. W. H. Cullen, one of its most generous benefactors.

* * *

Mr. GREGOR M. HENDERSON, Gas Manager at the Lasswade Works, Midlothian, is one of the new Councillors of the Burgh of Bonnyrigg and Lasswade.

* * *

Mr. TIMOTHY THORNTON, who has been Engineer and Manager to the Rowley Regis and Blackheath Gas Company for the past 26 years, has been elected one of the first Aldermen of the newly-created Borough of Rowley Regis. Mr. Thornton was recently appointed a Justice of the Peace for the County of Staffordshire.

OBITUARY

FRANK DAY.

We regret to learn of the death, at the age of 63, of Mr. Frank Day, Secretary of the South Metropolitan Gas Company, which occurred on Nov. 5 in a nursing home at Putney.

Mr. Day entered the service of the Company in June, 1885, as a junior clerk in the Rental Department. In 1912 he was appointed Chief Rental Clerk, and succeeded the late Mr. H. C. Sims as Accountant in February, 1914. He was appointed to the position of Secretary in 1920.

Mr. Day's high principles and courteous manner won for him the regard and esteem of all those with whom he came into contact. The appreciation of his devotion to the interests of the Company and its Co-partnership was evidenced by the presence of the President, Directors, and a large number of the officials and staff of the Company at the interment, which took place on Thursday last at Putney Vale Cemetery.

Correspondence

British Industries House

SIR,—Since I joined the Board of British Industries House I have been asked many questions about its purposes. May I explain very briefly?

The aim of British Industries House is twofold—first, to show a sufficiently representative collection of British goods in each of our principal trades to tempt the buyers in each of those trades to visit it; and, secondly, to attract a sufficiently large number of trade buyers regularly to justify the manufacturer in exhibiting.

I believe we shall succeed in both parts of our programme, and so make British Industries House a real living centre of Empire buying.

Yours, &c.,
FRANCIS GOODENOUGH.

British Industries House,
Marble Arch, London, W. 1,
Nov. 6, 1933.

According to the Report for 1932, which has recently been issued, the production of gas at the works of the gas undertaking at Zagreb, Jugo-Slavia, reached a total during the twelve months of approximately 229,861,000 c.ft., as contrasted with 226,411,000 c.ft. in 1931, an increase of about 1·52%.

Appointments Advertised To-Day.—Applications are invited for the position of Assistant Engineer and Manager to the Bath Company at a salary of not less than £650 per annum. Applications are also invited for the position of Works Manager at Cambuslang at £350 per annum less 5% economy cut.

Work is in Progress on the erection of a new Klönne type dry gasholder at the municipal gas-works at Lausanne, Switzerland. It is being built by the Sulzer Gebruder firm, of Winterthur, and will have a storage capacity of about 1,412,000 c.ft., its height being 172 ft. and the diameter 110 ft.

A New Demonstration Room has been opened at the showrooms by the Scarborough Gas Company, who have hitherto given occasional demonstrations in a local hall. The room measures 45 ft. by 23 ft., and is panelled attractively in Austrian oak. There is seating accommodation for 116 people, the chairs being of comfortable design and upholstered in leather. The new staff demonstrator is Miss Ruth Abbey, late cookery demonstrator to the Darlington Gas Department.

The Coleraine Borough Council, who recently discovered that they had no legal authority to supply gas to houses even in their own area, which they had been serving for 80 years [see "JOURNAL" for Nov. 1, p. 322], has decided to apply to the Ulster Ministry of Home Affairs for an Order constituting the Coleraine Gas-Works as a statutory undertaking. Alderman D. Cunningham gave notice of motion to rescind the decision to extend the gas supply to Portstewart, four miles distant.

The Halifax Gas Department reduced the price of gas in October, and for the first week in November held an exhibition of domestic gas equipment at the Marlborough Hall, at which appliances were offered at substantially reduced prices. The exhibition was from Oct. 30 to Nov. 11, and the reduced prices—together with corresponding reductions in rentals and quarterly instalments—applied to all orders placed during that period. The exhibition was opened by Sir Enoch Hill, Managing Director of the Halifax Permanent Building Society.

"Meter Reading and Collecting of Accounts."—Last week we published the paper by Mr. Thomas Carmichael, of Portsmouth, given at the Annual Convention of the American Gas Association in Chicago. The author points out that there was an error on p. 404. The last sentence in the right-hand column reads: "Each meter reader deals, on an average, with 110 meters per day, at a cost of 1·16d. per meter." This should be: "Each meter reader deals, on an average, with 110 meters per day, and every consumer costs the Company annually 1·16d. for four readings."

Gas Production in Delft.—From the annual report for 1932 of the Director of the Municipal Gas-Works at Delft, Holland, we learn that as a result of the general industrial depression there was—for only the third time in its long history of seventy-seven years—a slight decline in the production of gas, the output during the twelve months amounting to 214 million c.ft. compared with 224 millions in the preceding year, a falling off of about 4%. The number of gas meters in use in the town increased during the year from 11,603 to 11,708, of which latter no fewer than 6171, or 53%, are slot meters.

A Reminder.

Orders already arriving at the "JOURNAL" offices for the 1934 Edition of the "Gas Salesman's Pocket Book" indicate that gas undertakings are now looking to their staff diary requirements for next year. Those who wish to supply their employees with a pocket diary containing the maximum of useful information are reminded that there is a big discount on quantities of two dozen and over of the "Pocket Book," these being supplied at 2s. 9d. each instead of 3s. 6d. The new Edition, revised right up to date, will be ready as usual about the middle of December.

Successful Exhibition at Penrith.

The annual exhibition at Penrith, arranged by the Gas Engineer of the Urban Council (Mr. J. Corrigan) and his staff, was again very successful, there being a large attendance of the public during the week.

The exhibition included all the latest apparatus for lighting and heating, there being many pleasing new features. A novel display, which was very popular, was a coke fire, burning gas coke. Small bags of coke were sold at 1d. each, and the supply was soon exhausted. Mr. Corrigan called special attention to the new local product, "Penrith Graded Gas Coke," and pointed out that they were experiencing a heavy demand for this fuel for central heating and other purposes.

A neatly printed and helpful brochure, of which over 3000 copies have been issued, has been written by Mr. Corrigan, under the direction of the Council, giving in concise form the many uses to which gas may be put by the householder or other consumer. In an interesting, practical way Mr. Corrigan traced the history of the introduction of gas to the town 130 years ago, and also showed the great progress made since.

Doncaster Coalite Results.

Largely Increased Profits.

Doncaster Coalite, a subsidiary of Low-Temperature Carbonisation, which operates the "Coalite" process for the production of smokeless fuel, oil, and petrol from coal, reports that for the nine months to Sept. 30 last the gross profits amounted to £28,588, or at the rate of £38,117 per annum, which is more than double the gross profits of £15,704 for the whole of the preceding twelve months. This is equivalent to about 28% per annum on the whole of the capital invested in the Undertaking.

Debenture interest and depreciation absorb £15,247. A further £5188 is allocated to writing off the balance brought forward, leaving £8152. This is dealt with in making provision for the redemption of debentures to the extent of £6000, in payment of dividend on the preference shares and a dividend of 30s. per share on the £1 ordinary, leaving the carry-forward £97.

The Directors state that sales during the nine months amounted to £96,504, compared with £83,228 for the whole of the preceding year.

Modern Hospital Cooking.

Few people, other than those actively concerned in the administrative side, realize the enormous amount of cooking that goes on daily in a modern hospital.

"Modern Cooking Methods in Modern Hospitals"—an attractive booklet issued by the British Commercial Gas Association—deals exhaustively and practically with the subject. The Royal Free Hospital, London, for example, has a kitchen capable of dealing with 1000 dinners a day—mainly by gas, while St. Bartholomew's Hospital has a gas-equipped ward kitchen on each floor.

Forthcoming Engagements.

Nov. 18.—YORKSHIRE JUNIOR ASSOCIATION.—Visit to Brighouse Works. Paper by J. E. Wakeford.

Nov. 23.—SOUTHERN ASSOCIATION (EASTERN DISTRICT).—Meeting at 28, Grosvenor Gardens, S.W. 1, 2.30 p.m. Discussion on "General Installation Charges."

Nov. 23.—SOUTHERN ASSOCIATION (WESTERN DISTRICT).—Commercial Meeting, Rougemont Hotel, Exeter, 2.30 p.m.

Nov. 25.—NORTH OF ENGLAND AUXILIARY ASSOCIATION.—Half-yearly Meeting at Newcastle. Paper by Dr. G. P. Lishman, F.I.C.

Empire State Building.

IN NEW YORK

WITH THE INSTITUTION

BY THE EDITOR.

Our tour was drawing to a close when, on Wednesday morning, Oct. 4, we left Philadelphia, with its many historical associations, for the excitement of New York, with its bustle and its mile upon mile of glittering Broadway. But no one gave a thought to coming partings, in the pleasing atmosphere created by the geniality of those who met us upon our arrival in New York. This was followed by an informal luncheon, at which Col. O. H. Fogg, Vice-President of the Consolidated Gas Company of New York, welcomed us on behalf of the Metropolitan Gas Companies.

The Reception Committee had for Chairman Mr. C. E. Paige, Vice-President of the Brooklyn Union Gas Company, while other members of the Committee were Mr. P. S. Young, Vice-President of the Public Service Electric and Gas Company, Newark (N.J.), Mr. A. J. Gonnoud, President and General Manager of the King's County Lighting Company, Brooklyn, New York, Miss Mary E. Dillon, President of the Brooklyn Borough Gas Company, Coney Island, Mr. William J. Welsh, President of the New York and Richmond Gas Company, Staten Island, N.Y., Mr. Donald McDonald, Secretary of the American Meter Company, New York, N.Y., and Mr. H. Leigh Whitelaw, Vice-President of the American Gas Products Corporation. Then there was Major Alexander Forward, the Managing Director of the American Gas Association, who, during the time we stayed in New York, devoted himself wholeheartedly to the task of increasing our knowledge of his wonderful city. We were, indeed, greatly indebted to the gentlemen named for all they did for us, and also to the chief officials of the various Gas Companies in the State of New York, who were ever anxious to show us everything of interest.

After lunch we were taken in a fleet of cars, again with a motor cycle police escort, which made things remarkably easy for us, to the Polo Grounds, where many of us had our introduction to a first-class game of baseball. The teams engaged were the "Giants" and "Senators"—the "Giants" representing New York, and the "Senators" Washington. The former won the match, which was the second game of the World's Series, 1933. Along with the huge crowd present (which must have numbered between 40,000 and 50,000) we thoroughly enjoyed the game, though, not understanding the finer points, we were perhaps less demonstrative.

The attractions of New York are so multifarious, and our time limit was so restrictive, that it was impossible for us to see anything like all that we would have wished, so that in the main we were divided up into quite small parties, in which way we managed to see quite a lot in the directions which most appealed to us.

One of the occasions on which we were all in one party was during a steamboat trip for an inspection of New York waterfront. This was an unforgettable experience. As was usual during our tour, fine weather favoured us, and bathed in sunshine the scene was one of extraordinary

[*Canadian Pacific Railway Photograph.*

NEW YORK WATERFRONT.

Showing the Woolworth Building to the right.

beauty. Strange as it may seem, the uneven skyline (created by the tendency of Americans—and Canadians—to erect, where suitable foundations exist, extremely tall buildings), becomes the more attractive the longer one gazes upon it; and on this occasion the reflection of the sun from one or two polished domes, &c., gave to the scene an added splendour. We saw the view from both the Hudson River and the East River, with its Brooklyn and Manhattan Bridges; and we were afforded a close-up sight of New York's outpost, the Statue of Liberty.

Some idea of the skyline to which reference has just been made will be gathered from the photograph reproduced here, which shows, among others, the famous Woolworth Building (792 ft. high). Tall as this building is, there are now two which surpass it in height—the Chrysler Building and the Empire State Building, the latter being the tallest man-made structure in the world.

Empire State Building.

In order to erect the Empire State building, it was necessary to demolish the Waldorf-Astoria Hotel, which occupied the site on Fifth Avenue where the Astor Mansion formerly stood. This site is about two acres in extent, but on only a quarter of this area could they build to any considerable height, because of the limitations of the city zoning laws. Sixteen times did the Architect draw plans for the building before every requirement was completely met. Five floors constitute the base of the building, and on this base there is a terrace 60 ft. broad. From this point, the building springs straight up to the 86th floor lower observatory.

It is easy to believe the claim that the Empire State building is the tallest man-made structure in the world. It is 1250 ft. high—102 storeys from the street to the high observatory, and, as already mentioned, 86 storeys to the lower observatory. There are two storeys below the street. The Chrysler building, its nearest competitor, is 1046 ft. to the top of its finial spire, while the Eiffel Tower is 984 ft. tall.

The Empire State building will house 25,000 tenants. An additional floating population of 40,000 daily visitors can be accommodated, and in an emergency it could shelter 80,000 persons. Such a building as this is, of course, only practicable when founded on rock. This will be understood when it is mentioned that the Empire State building is comprised of 303,000 tons of steel, stone, and materials. The " skyscrapers " of Manhattan rest upon an underlying stratum of granite. On the spot chosen for the Empire State building bed-rock was near, and, as already pointed out, the building goes down only two floors, or 33 ft., below the sidewalk. There it stands, the base of its columns bedded deep into the granite stratum.

A brilliant appearance has been given to the building by the use on the outer walls of chrome-nickel—an alloy which never tarnishes. Between the top of each window and the sill of the window above, there is placed a flat plate of dull silver aluminum, sand-blasted to obtain a velvety surface. For the service of the building there are sixty-three self-levelling elevators, which are capable, if required, of rising or descending at a speed of 1200 ft. a minute. There are also four freight elevators. Express lifts can reach the 80th floor in less than one minute. Tower elevators from the 80th to the 86th floor, and a mooring mast elevator from the 86th to the 102nd floor carry visitors to the observatories.

On May 1, 1931, the Empire State building was formally opened to the public—less than two years from the beginning of demolition on the site.

A Cheery Evening.

On the Thursday evening we were the guests at dinner in the Waldorf-Astoria Hotel of the Companies already mentioned as being represented on the Reception Committee. Mr. C. E. Paige occupied the chair, with Mr. G. B. Cortelyou supporting him. Mr. Cortelyou, President of the Consolidated Gas Company of New York, has for many years been closely connected with the Gas Industry of the United States, and was the first President of the American Gas Association. During the dinner, the Chairman said it was his pleasure to introduce to those present Mr. Campbell, British Consul General in New York.

It was a cheery evening, and we all heartily echoed the hope expressed by Mr. Paige that the acquaintances thus auspiciously made might become lasting friendships. Mr. Tarratt voiced our unanimous view, when he said that such meetings as this could not fail to advance friendship. Mr. Cortelyou made a short speech, which he prefaced with the remark that to be a member of a public utility undertaking was an opportunity for service.

Early History of Gas Supply in New York.

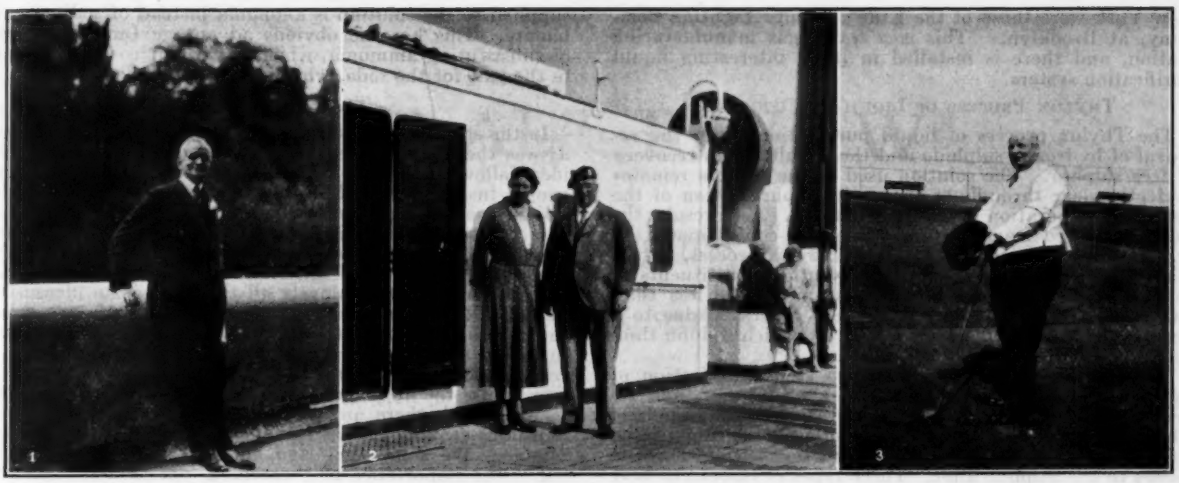
Mr. Cortelyou, in an address delivered before the Princeton University in the Cyrus Fogg Brackett Lectureship in Applied Engineering and Technology, said: In 1823, the New York State Legislature granted a charter to the Gas Light Company of the City of New York. A few weeks later the Common Council granted permission to lay mains in the city streets. Work went on apace, materials and equipment being imported from England; and in March, 1825, gas first was used in New York City. At that time our present great Metropolis consisted of several villages and many farms, containing an aggregate of 120,000 inhabitants. At Dec. 31, 1931, there were no less than 1,964,585 meters, through which 65,600,534,000 c.ft. of gas were sold in 1931 in the boroughs constituting Greater New York, with a population of more than 7,000,000 persons.

The early gas applications were for lighting, and the cities were especially interested in street illumination. In 1826 there was initiated a quaint custom in the City of New York which continues to the present time—the maintenance by the city of the lights at the entrance to the home of its Chief Executive. The first Mayor to be so honoured was Philip Hone, who lived on the site of the present Woolworth Building. The gas production plants of those times were all manually operated, and long working hours were the order of the day. There developed a new type of worker—an admirable combination of brain and brawn. In later years, as machine displaced hand labour, the Gas Industry attempted to pay some small

[*Photo. by Aerofilms, Ltd., reproduced in " West's Gas " Summer Number.*

AN AIR VIEW OF MANHATTAN AND THE SKY-SCRAPERS OF NEW YORK'S "DOWN-TOWN" AREA,

Showing the Docks and East River in the foreground and the Hudson River beyond.



(1) Mr. John Keillor travelled more than 3000 miles overland from Vancouver, to attend the Ottawa Convention of the Canadian Gas Association, at which he read a paper. (2) Mrs. Braidwood, with Mr. George Braidwood, of Coatbridge, who represented the North British Association of Gas Managers. (3) Mr. J. D. Smith, of Belfast, who represented the Irish Association of Gas Managers, is always ready to strike a blow in a good cause.

tribute to him. His virtues were immortalized in a poem written by another much respected gas man, Walton Clark, of Philadelphia. Mr. Clark took as his title a phrase for which the Industry has always had a sentimental fondness—"The Gas House Terrier." These are two of the verses:

He was a grimy Terrier from the gas house down beyant.
Of chemistry and algebra his knowledge true was scant;
But he'd a horny fist and an honest face, and the grit of a brindled pup;
He didn't go much on photometry, but he kept his holder up.

As we welcome the logarithmic boy, with his tubes and chemical stuff,
Let us not forget the Terrier lad, who broke the way when the way was rough.
Here's to his joy, wherever he goes, and may never a fate be sweeter
Than his, when death cuts off his gas, and Gabriel takes his meter.

And To-Day.

At the present time, the rated capacity of the gas manufacturing plants of the Consolidated Gas Company of New York and its Affiliated Gas Companies is 295,852,000 c.ft. daily, made up as follows: Water gas, 242,052,000 c.ft.; coal and oven gas, 53,800,000 c.ft.

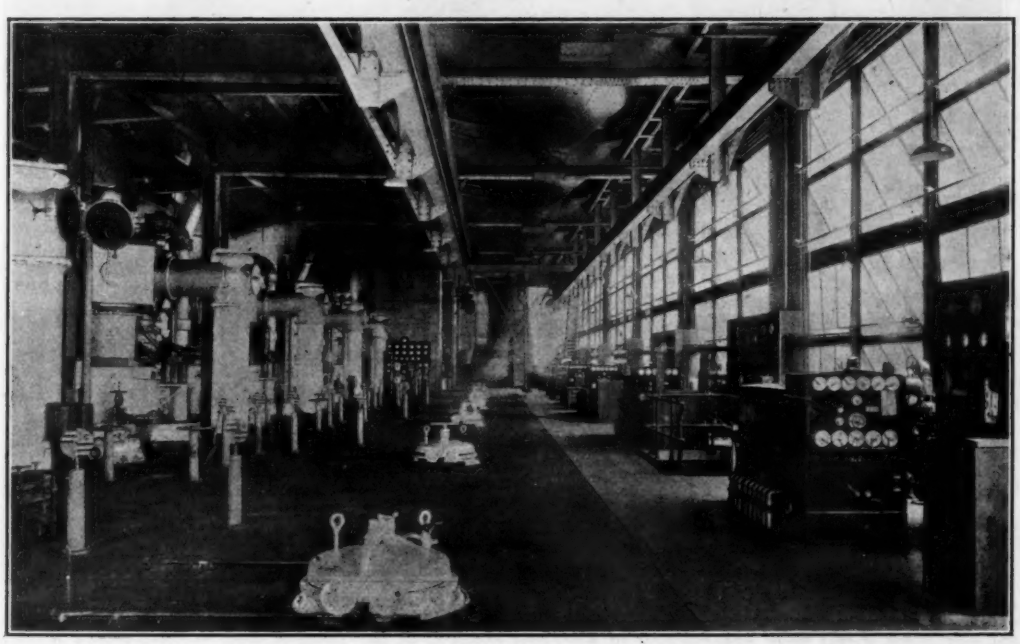
The capacity of the Astoria gas manufacturing plant is 91,500,000 c.ft. daily, and of this amount 20,000,000 c.ft. is coal gas and 71,000,000 c.ft. water gas. The capacity of the Hunts Point plant is 60,000,000 c.ft. of gas daily, of which one-half is coke oven gas and the other half water gas. There are more than 3000 miles of mains in the system.

The report for the Company for 1932 states that there are at present 1,322,482 gas meters on the district, and that the sales of gas in that year amounted to 41,170,403,800 c.ft. The Companies furnishing gas service supply a territory having a population of about 5,000,000.

A Visit to Brooklyn.

Some of us went to one works; some to another. The particularly energetic members of the party visited several. Of much interest was the oil gas reforming plant of the Brooklyn Union Gas Company, and the carburetted water gas plant, with its self-clinkering generators, of the New York Consolidated Gas Company. Plants of the character of these two were, however, fully described in the article dealing with the visit to Philadelphia, and there is no need to go over the same ground again now.

The works selected by the writer for inspection while in



CONSOLIDATED GAS COMPANY OF NEW YORK.

Hunt's Point Station, The Bronx. Water-Gas Unit, Generator House Operating Floor.

New York were those of the King's County Lighting Company, at Brooklyn. This is a water gas manufacturing station, and there is installed in it an interesting liquid purification system.

Thylox Process of Liquid Purification.

The Thylox process of liquid purification is for the removal of hydrogen sulphide and the simultaneous recovery of free sulphur. The solution used in the process remains perfectly clear throughout the cycle of purification of the gas and regeneration of the foul solution. As a result, the sulphur filtered from the solution is not contaminated by other solids. Soda ash is used in the Thylox process, but its alkalinity is partially neutralized by other constituents of the solution. Soda consumption is said to be less than half that of previous sulphur recovery processes, due to a decreased rate of secondary reaction by which sodium thiosulphate is formed.

The process is carried out in two steps—absorption of hydrogen sulphide from the gas to the absorber, and regeneration of the foul solution by aeration in the thionizer. The sulphur floats up into the froth at the top of the thionizer and overflows into a slurry tank, from which it passes to the sulphur filter. Three types of thionizers have been used, of which one is the pressure type installed at the King's County Works by the Western Gas Construction Company of Fort Wayne. This pressure thionizer, which is the newest type, consists of a tall narrow tower, into the bottom of which the foul solution is pumped while compressed air is blown in simultaneously at the bottom through a perforated pipe. A sulphur separator is provided at the top of the thionizer to float off the sulphur, which passes to the sulphur slurry tank. The advantages of this type of thionizer are that it takes up very little space, is simple to construct, and that it requires a relatively small amount of air for efficient actification.

Among the papers read at the Chicago Convention of the American Gas Association, was one by Messrs. Fred. Denig and A. R. Powell, of the Koppers Research Corporation, Pittsburgh, in which the authors stated that another new development in liquid purification, which is so economical that the bye-product sulphur obtained will, in many cases, cancel purification costs, is the Modified or Ammonia Thylox Process, developed by the Koppers Company. In general, this is very similar to the Soda Thylox Process, the chief point of distinction being that the alkaline material supplied to the solution is ammonia instead of sodium carbonate. This has the obvious advantage (among others) of substituting ammonia, which is without cost as it exists in the gas, for the soda, which must be purchased.

The Service Side.

In the showroom window of the King's County Company, as was the case in other cities visited during the tour, the idea followed up is to make an appeal which will bring people inside. An admirable display on the day of the visit was a gas operated refrigerator, and nearby a picture of a mouse eating a piece of cheese. There was no trace of fear on the mouse's countenance, thus pointing to the silent action of the refrigerator—" as quiet as a mouse." The aim of every employee, all the time, is to please the public. Here is a Home Service Director with two assistants who go out on the district. With every delivery made by the Company, whether (say) of a range or of a refrigerator, these girls call on the consumer and explain how to use the appliance. One afternoon and one evening in each week there are demonstrations, and on Saturday mornings cooking lessons for children of from 8 to 16 years of age. We some time ago emphasized in the " Journal " the importance of " catching 'em young "—an importance which is fully realized, too, by the electricians.

There is a comfortable and commodious demonstration room, which on three afternoons a week is available for card parties. Whoever is responsible for the party has to guarantee an adequate attendance. The Company supply tables, chairs, and refreshments; the only obligation resting upon the card players being to listen to a short lecture on some special cookery operation. The system of monthly accounts has been in operation here for a long time past, and has been found to work very satisfactorily indeed. This is what the Directors of the Company said regarding service in their report for the year 1932: " The Home Service Division made new contacts through lectures, card parties, private lessons, and other home visits, with 14,905 women and children, giving 127 lectures and talks and conducting 76 classes on various cooking topics. There were 53 card parties for various local organizations which were attended by 2650 women, and which were supervised by the Home Service representatives. The area available in our Main Office basement was used by 115 organizations, who held fairs, parties, and other meetings for charitable or social purposes, which were attended by 21,320 people."

Gas Lighting of a Railway Station

Our photograph (for which we are indebted to Mr. H. E. Copp, Engineer and Manager, Hull Station of the British Gas Light Company, Ltd.) is of the interior of Paragon Station, of the London and North-Eastern Railway, Hull, the gas lighting of which has been recently modernized. Gas was adopted by the Railway Company in the face of very keen electrical competition. It will be seen that the platforms are brilliantly and evenly illuminated. Each platform is 700 ft. in length, and the lighting is separately controlled from a by-pass tap situated at the entrance to the platform.

THE "JOURNAL" REVIEW

Of the Institution Research Meeting. A Full Report Follows.

The President, Mr. Frank P. Tarratt, must have been gratified with the attendance when on Tuesday morning, Nov. 7, he rose to welcome those present at the Fifth Autumn Research Meeting of the Institution of Gas Engineers. The meeting was held in the Hall of the Institution of Mechanical Engineers.

One looked in vain for the presence of the Hon. Secretary, Mr. W. E. Price, on the platform. The President explained that Mr. Price had been ordered by his doctor to take a rest. A letter expressing sympathy was sent to Mr. Price, from whom, during the course of the meeting, a telegram of thanks was read.

Greetings from Abroad.

The Secretary, Mr. J. R. W. Alexander, announced the receipt of telegrams conveying good wishes for the success of the meeting from Herr Fritz Escher, of Zurich, President of the International Gas Union, and from the Presidents of the Polish and Italian Gas and Water Associations. It was agreed that suitable response should be made to these welcome messages.

Ten Years of the Education Scheme.

The first report to be discussed was that of the Education Committee for 1932-33, which was presented by Sir Francis Goodenough. The Education Scheme of the Institution has now been in operation for ten years, and appropriately the report surveys its progress. The growth of the education work of the Institution during the decade can be measured from the fact that at the end of the first year in 1924, 36 internal students were presented by four Approved Centres for examination and 24 external students were examined—a total of 60 candidates—while in 1933, 312 internal students were submitted by 26 Approved Centres for examination, and 105 external students were examined, a total of 417 candidates. There are now 43 Approved Centres for Major Courses in Gas Engineering and/or Gas Supply, compared with 11 Approved Centres in 1924. The number of candidates for the Gas Fitting Examinations conducted by the City and Guilds of London Institute in co-operation with the Institution has increased to such an extent that difficulty has been experienced in securing sufficient suitable examiners for the practical part of the examinations; and the report asks that gas engineers and managers should release men for this work. Certainly the proper qualification of those who come frequently into contact with the consumer is of the utmost importance.

As for the Examinations in the major subjects, the number of candidates in 1932 was practically the same as the number in 1931—which showed an increase of no less than 37% over the previous year. The number of candidates who presented themselves for the Examinations in the Minor Courses and Gas Fitting was approximately the same as last year. The report of the Board of Examiners emphasizes the need for a sound general education. Students have not yet realized how important is clarity of expression.

A Wealth of Suggestion.

Presenting the report, Sir Francis Goodenough, who is Chairman of the Committee, said that a measure of the progress which has been made since the inauguration of the Education Scheme is given by the increased number of students presenting themselves for examination. Sir Francis, having paid a tribute to the help which Mr. John Terrace has afforded the Education Committee, emphasized the value to the Industry of the short course for teachers, organized by the Board of Education and so enthusiastically and efficiently conducted by Mr. C. H. Creasey. "I am sure you will all agree," concluded Sir Francis, "that the Education Scheme of the Industry is designed for the preparation of a man for his life and for his livelihood, and not merely for the taking of certificates."

Mr. Tarratt referred specially to the work of the local centres, which he described as "the heart of the whole concern." Col. Carr—a member of the Committee—spoke of the excellent voluntary service given by the Board of Examiners, constituted of very busy men willing to devote their time to benefiting the juniors. Two lessons, suggested Col. Carr, are to be learned from the Report of the Examiners. First, are the responsible administrators of the Industry providing adequate facilities for the all-round training of juniors on the works—in the drawing office, the general works laboratory, the fuel laboratory? He thinks not, and urges a remedy. Then, is not a great mistake being made in saying to a junior, You are on the distribution side, or you are on the manufacturing side? Early specialization is not for the good of the Industry; an efficient distribution man must have a knowledge of gas manufacture. "At present, almost 99% of the gas fitters visiting consumers' houses, and who are the main arteries connecting the blood stream of our undertakings with the users of gas, know nothing about the material they are handling other than that it is gas." Mr. Terrace appealed to chief executive officers of gas undertakings to become personally acquainted with the efforts made by the staff and workmen in attending classes of instruction and in gaining certificates.

The remarks of Dr. J. N. Long, Principal of the Westminster Technical Institute, were followed with keen interest. He stressed that more importance should be attached to ancillary subjects. "If all the subjects were of equal importance, the Industry would get a trained candidate at the end of three years. As it is, you are getting a candidate well qualified in gas subjects, but absolutely poor in ancillaries." Generously trained employees will not be obtained by emphasizing the main subject. Dr. Long pointed out that, if students happen to be "courting," their evenings of love coincide with the evenings on which ancillary subjects are taught. He did not mention, however, that to those in love all other subjects may appear ancillary. His suggestion is that the Institution should set about removing the inferiority complex which now exists in respect of ancillaries.

Executives who advise students need to be careful to advise the right type of man to take the right type of course. Unsuitable students with a flair for examinations may take courses which lead nowhere. This is the gist of the comments by Mr. F. C. Briggs, of Dudley. "It is a reflection on the Gas Industry," he remarked, "that so many of our best men, having been trained, are scooped up by the contractors." The moral is obvious.

New Diplomés and Medallists.

Then came the presentation of Diplomas. In all, fourteen Diplomas were awarded—only one, however, being for Supply. The candidates who gained First Class Diplomas in Gas Engineering (Manufacture) are A. W. J. Harris, B.Sc (Chem.), B.Sc. (Eng.), London; F. O. Hawes, London; and K. C. Mead, London. Those who gained Second Class Diplomas are J. J. Brown, Liverpool; J. M. Brown, B.Sc., Liverpool; A. S. Brush, Silloth; A. W. Elliot, Elland; A. J. Leather, Blackburn; F. Lowe, Ramsgate; A. H. Pinder, Birmingham; H. J. Risby, London; K. Snowdon, Musselburgh; and K. E. Tiddy, Haverfordwest.

The Diploma in Gas Engineering (Supply), Second Class, was awarded to F. L. Atkin, A.M.I.Mech.E., of Birmingham.

Research in General.

Next to be presented was the Fourth Report of the General Research Committee, which summarizes the separately published reports submitted at the meeting and dealt with later in our Review. It is mentioned in the report that the experience gained during the investigation

of the manufacture of water gas by the Joint Research Committee indicates that more economical every-day working of water gas plants could be obtained by the adoption tion of chemical control. Broadly, the efficiency of a plant is obtained from the amounts of coke, steam, and oil required to produce a given thermal yield of gas and the performance expressed in terms of these items is the ultimate concern of the gas engineer. Figures on this basis can be arrived at without difficulty, but they are not of much help in the operation of the plant. While showing the degree of efficiency attained, they give no indication of the manner in which losses have occurred, or, consequently, of the ways in which the method of operation might with improvement be modified. It has been noticed repeatedly that the appearance of the fire, temperatures in the carburettor and superheater, composition of the water gas made, &c., are not reliable guides for the fixing of the conditions for the most efficient working. More useful measurements would be those concerned with the fundamental reactions of the process—*i.e.*, with the liberation of sensible heat in the generator, carburettor, and superheater during the blow and with the utilization of this heat during the run. Such measurements have been included in the Committee's previous tests on water gas, but these tests were purposely made as complete as possible using methods essentially of a research character.

Accordingly the investigation on water gas at present in progress is directed towards the development of a code of chemical control suitable for works routine purposes. In addition to the direct economies which would most probably result from the use of chemical control, its general adoption would be attended by the further advantage of permitting a more ready comparison of the behaviour of different plants. The work necessary for the preparation of the code can be divided into three phases. First, the theoretical consideration of the manufacture of water gas, with a view to the selection for observation of those items which give a measure of the losses which occur at various stages of the process; secondly, the design of the simplest possible apparatus and experimental methods for the observation of the selected items; and thirdly, the collection of existing data on water gas plants, supplementing it by direct tests where necessary, in order that figures shall be available which will serve as a guide in the application of chemical control. These figures should indicate how the losses incurred in the process are influenced by such factors as the ratio of the amount of steam supplied on the run to the volume of air supplied on the blow, the depth of the fuel bed, the size of the coke used, the automatic extraction of clinker, temperatures in the carburettor and superheater, amount of oil used, &c.

Progress is being made along these lines, but the results have not yet reached a stage to warrant publication and discussion.

In regard to the work of the Gas Appliances Sub-Committee, the methods of testing gas fires employed by the individual members have been and are being subjected to a most rigorous theoretical and practical examination. The degree of precision that is obtainable with the instruments available, and the effect of the human factor on the results obtained, have been given special attention. It has been agreed that at present all results should be based on the gross calorific value of the gas used and that, with the equipment available, it is not to be expected that the accuracy of the results can be closer than plus or minus two per cent.

The work is proceeding and a series of standard fires is being tested in turn, under specified conditions, by a number of independent workers.

Industrial Centres.

District Industrial Gas Centres have been, or are being, established in Birmingham, Bristol, Cardiff, Glasgow, Leeds, Liverpool, Manchester, Newcastle-upon-Tyne, and Sheffield by the respective gas undertakings, and in London by the Gas Light and Coke Company and the South Metropolitan Gas Company. The gas undertakings in the area surrounding each centre may avail themselves of its services by contributing towards the cost of its maintenance. The Scheme covers the utilization of gas for all large and small scale industrial and commercial purposes and is co-ordinated by a Joint Co-Ordinating Committee appointed by, and equally representative of, the Institution of Gas Engineers, the National Gas Council, and the British Commercial Gas Associatina. The members of the Industrial Gas Committee of the Institution are members of the Joint Co-Ordinating Committee.

Lighting.

The Joint Lighting Committee has nearly completed a Draft Specification for Gas Mantles, agreeable to users and makers, which it is hoped the Council of the Institution will be able to submit to the British Standards Institution for issue as a British Standard Specification.

The Committee continues its investigation of the factors affecting the performance of gas street lamps—that is, of the depreciation in illumination due to dirt, ageing of light source, and other factors which may occur under "service" conditions. Alexander Wright & Co., Ltd., have afforded valuable help in making the necessary and numerous tests required in the different districts. The investigation was primarily undertaken to ascertain the tolerances required for gas street lamps, between the rated and service conditions of the British Standard Specification for Street Lighting, consideration of the revision of which continues. The results of the investigation, however, will be found to be of great assistance to lighting engineers in the regulation of cleaning and maintenance operations.

The discoloration of walls and ceilings by dust carried in air set in motion by heated surfaces, &c., is a familiar problem to heating and ventilating engineers. Gas lighting, by promoting the rapid movement of the air, may be regarded as an aid to ventilation, but is attended by discoloration of adjacent surfaces. The subject is under consideration by the Committee, with a view to finding means of further reducing such discoloration.

Gas Research Fellowship.

Mr. T. H. Blakeley, B.Sc., was elected to the Fellowship for a second year, but the presentation of his Report has been prevented by illness.

Results have been obtained in determinations of reactivity made on a number of carbonized fuels at temperatures of 900°-1400° C. The fuels vary from a highly reactive cocoanut charcoal to a highly unreactive graphite, the two fuels of intermediate reactivity being a coke prepared at 900° C. from a moderately coking (New Hucknall) coal and one from a fusible strongly coking (Holmside Durham) coal. The reactivity of each fuel rises with temperature, the increase in reactivity being very marked, as might be expected. It is noticeable that differences in reactivity still persist at the higher temperature. Experiments were made on cokes which had been given a previous heat treatment at 1400° before the reactivity determinations were made. This treatment had materially lowered in each case the reactivity at 900° C. These differences in reactivity can be shown to persist at high temperatures, but it must be remembered that the demonstration and determination require special experimental methods. It is highly probable that in technical applications, the reactivities for all these fuels will have been so enormously increased at such a temperature as 1400° C., that they will react as rapidly as the gas, for example CO_2, can be supplied to them, so that the rate of gasification will come to depend upon some factor other than that of reactivity. The position is, in that respect, analogous to that obtaining with reactivity to oxygen at much lower temperatures.

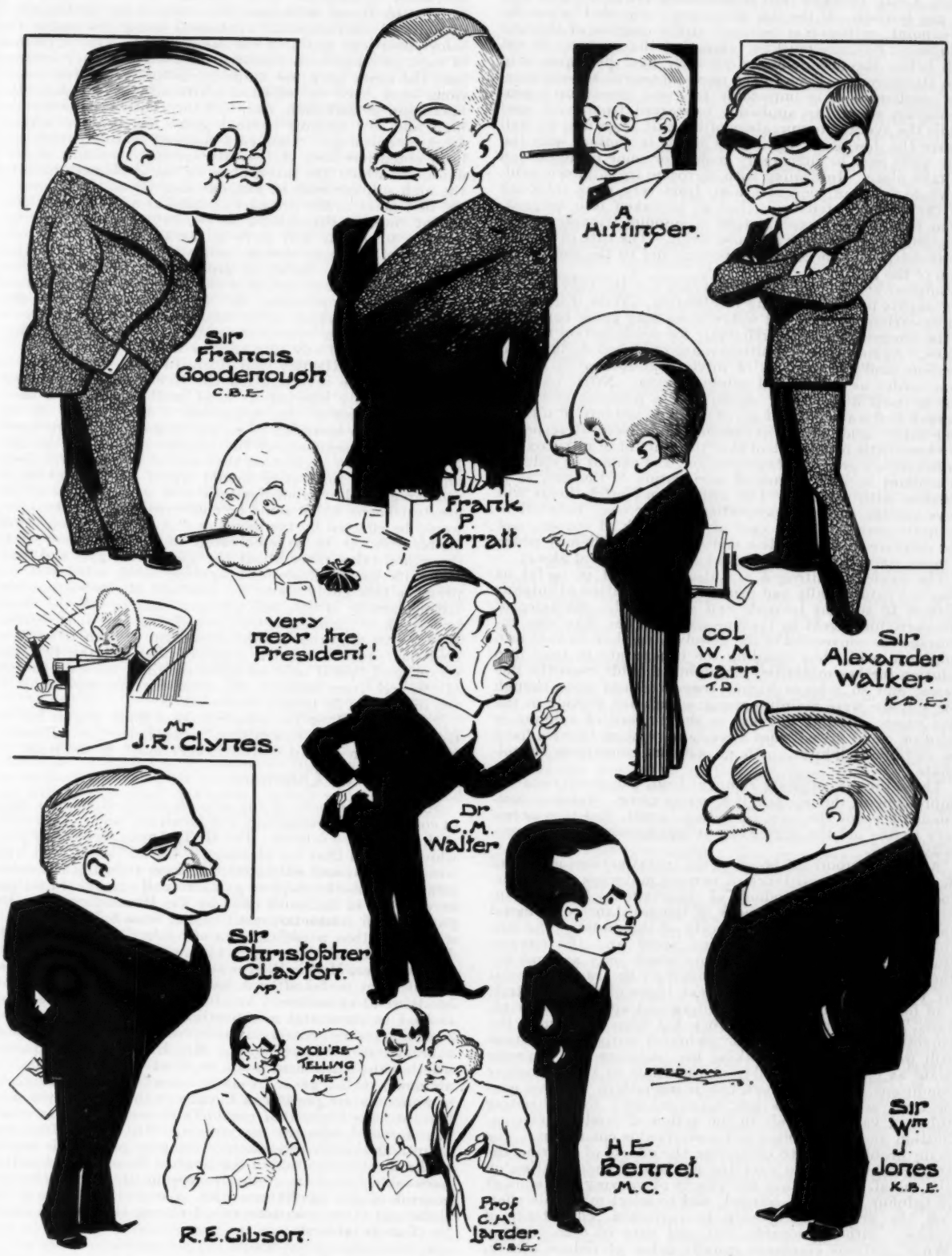
Research with a Kick in It.

Following Mr. R. E. Gibson's presentation of the report, Mr. Thomas Hardie expressed the view that during the year the General Research Committee had shown much more life than in the three preceding years. Then Mr. Robert Watson, Chairman of the Joint Lighting Committee, asked members to avoid apathy in connection with the lighting load. In Doncaster, he said, prepayment consumers represent 75%, and no less than 50% of the total consumers use gas for lighting purposes. The domestic gas lighting load represents 20% of the sales, and public lighting 10%. Among municipalities throughout the country which own neither gas nor electricity works, 81% of the lamps are gas; where municipalities own both services, 78% of the lamps are gas. Only where municipalities own electricity but not gas-works is the percentage of gas lamps low—a matter of 42%.

As Chairman of the Meters Committee, Mr. Terrace explained that the Committee has had a number of tests carried out with the object of trying to determine what the consumptions are by various classes of consumer. From these tests the conclusion has been arrived at that 100 c.ft. per hour will cover the requirements of most prepayment users; that 200 c.ft. will cover the requirements of most ordinary consumers; and that for the large ordinary consumers a 400 c.ft. per hour meter will meet the case.

Corrosion from Combustion Products.

Tuesday morning's session was brought to a close by presentation and discussion of a report of the Joint Research Committee on "Corrosion from Products of Combustion of Gas," the Research Chemist being Mr. J. W. Wood. It is usually assumed that the sulphur compounds



SEEN DURING THE RESEARCH MEETING BY FRED MAY.

in the gas—or, rather, their oxidation products are in the main responsible for corrosion; and it is pointed out in the report that the theoretical air-free products of combustion of a typical gas will contain 0·01% of sulphur dioxide. Also, 1 c.ft. of water will be produced for each cubic foot of gas burned. If the flue gases are not cooled below the dew-point, corrosion is reduced, at the expense of thermal efficiency; but care must be taken that the products do not fall below the dew-point before their final discharge into the atmosphere. Even in the most successful non-condensing appliances it is impossible to avoid momentary condensation when the appliance is started from cold, and while the average temperature of the exit gases may be well above the dew-point, the layers of gas in contact with the flue walls may be sufficiently cooled for some condensation to take place. In dealing with corrosion by sulphuric acid, a whole range of concentrations, from very weak solutions to the concentrated acids, has to be taken into account, even though the concentration of sulphur trioxide in the original flue gases may be quite small. The rate of attack, moreover, is not necessarily proportional to the concentration of the acid.

Sulphur acids, it is pointed out, are not the only corroding agents produced during combustion. With iron appliances carbon dioxide and water alone may cause corrosion if the temperature falls sufficiently for condensation to take place. Again, oxides of nitrogen are produced during combustion, and the amount of nitric acid formed is of the same order as the typical sulphur figure. Nitric oxide is not in itself a corroding agent, but in presence of excess oxygen and water vapour gives rise to a mixture of nitrous and nitric acids. This is important in several respects. We have little or no control over the amount of nitric oxide, since this is a product of combustion, and cannot be reduced in amount by any scheme of purification of the gas, as is possible with sulphur. The nitrous and nitric acids will have specific corrosive properties of their own, believed to be quite marked in the case of the attack of copper, and the mixture of dilute nitric and sulphuric acids may prove a more vigorous corroding agent than either acid alone.

The oxides of nitrogen are also important in so far as they act catalytically and promote the oxidation of sulphur dioxide to sulphur trioxide and so alter the character of the corroding agent in the flue gases. They may also encourage the conversion of the dissolved sulphur dioxide into sulphuric acid, thus enabling the condensate to take into solution further quantities of sulphur dioxide from the flue gases, and so achieve higher concentrations even though the sulphur were mainly present as sulphur dioxide in the flue gases. Similar increase in the amount of sulphur in solution could arise if that already in solution became fixed as metallic sulphites, with or without conversion to sulphate.

Thus, though sulphate removal from gas must result in improvement, the problem is a complex one. Sulphur compounds are not the only corroding agents, and it is necessary to find out the degree of purification which is economically sound.

A second important phase of the investigations is that of determining the resistance of various materials to the corroding influence of products of combustion. It would appear to be a mistake to speak of the resistance of a metal to corrosion as a specific property of the metal. The corrosion depends upon the active agent and the circumstances of its application, factors which may account for the very different values attributed to the same material by various workers using different types of corrosion test, and for the difficulty of reconciling and applying their results. Much fundamental work has been done upon the corrosion of metals, but for technical purposes one must still work empirically, making the corrosion test approximate as closely as possible in essentials to the particular conditions of use in which one is interested. In this connection, an apparatus has been designed for subjecting tubes of various metals to the action of products of combustion under controlled and reproducible conditions. The main problems are to determine the effects of altering the temperature so as to vary the amount of condensation on the metal, to ascertain the effects of varying the amount of sulphur in the gas burned, and to select materials offering the greatest resistance to corrosion, consistent, of course, with reasonable cost and ease in manufacture. While coatings employed usually delay or reduce attack, they are not as yet sufficiently homogeneous and resistant to afford a permanent protection against corrosion.

A *New Slogan for the Industry.*

The first speaker in the discussion was Mr. C. A. Masterman, who, as one on the utilization side, congratulated the engineering side on the consistently high quality of the gas now produced, which alone makes possible certain developments in utilization technique. The report, he said, draws attention to the benefits which would follow a reduction in the sulphur content of town gas. It is too early yet to state what the economic limit for sulphur may ultimately be found to be, but there is clearly need for co-operation between the utilization and manufacturing sides. At Watson House tests have been carried out on a number of pairs of characteristic appliances using gas under the same conditions and over the same period. One appliance of each pair has been operated on a high sulphur content gas, the other on a low sulphur content gas. The conditions have been so adjusted artificially as to cause the maximum of corrosion, &c., but the contrast between the high and low sulphur content gases has been in several cases astonishing. One very marked feature which has been noted has been the greatly increased amount of condensation which has taken place in the appliances burning the high sulphur content gas, due directly to the raising of the dew-point in the presence of sulphur oxides. Any consistent lowering throughout the country of the sulphur content in town gas will have a marked effect on certain features of appliance design, and will make easier the task of the designer. An allied problem lies in the decreased condensation and corrosion in the flues attached to central heating boilers operating on low sulphur content gas. Again, any reduction in the sulphur content of gas would be reflected in the comfort conditions obtained where flueless appliances of any sort may be used.

Dr. Harold Hartley put forward the view that, in authorizing the investigation the General Research Committee is really burying its head in the sand. "I think everybody knows," he remarked, "that much of the trouble due to corrosion of metals in gas consuming appliances is a consequence of the sulphur content of the gas. I have heard no suggestion that one of the Research Committees of the Institution should report on the problem of removing sulphur from domestic coal gas . . . one of the greatest boons which could be conferred upon our Industry would be effected by the devising of a process which would enable sulphur to be eliminated *in toto*. When public discussion takes place about the use of coal gas, and especially its use in flueless apparatus, many advocates are prone to talk glibly about the products of combustion consisting largely of CO_2 and nitrogen, and to tell the world at large how harmless is CO_2, yet all the time it is realized that the 20-30 grains of sulphur present in each 100 c.ft. of coal gas cause a greater nuisance than all the CO_2 and steam, and that if only we could obtain a domestic supply of gas free from sulphur, the scope for the application of the fuel would be largely increased."

"SULPHUR MUST GO would make a good slogan for the General Research Committee," concluded Dr. Hartley, whose opinion on this matter is very much to the point.

A *Battery of Questions.*

Mr. F. Firth spoke of the possible effect of sulphur acids in contact with decorations and furniture, and in particular with mordanted fabrics. Dr. H. T. Angus mentioned work which showed that the cleaning of the surface of cast iron, wrought iron, and mild steel, far from reducing the corrosion resistance to sulphur acids actually increased it; and he referred to the work done by the Birmingham Gas Department in connection with copper back-boilers, where it was found that a surface skin of oxide did not reduce the deterioration of the copper by high-sulphur cokes. The next speaker, Mr. G. B. Howarth, suggested that the bending of sheet metal after it has been electro-plated cannot be allowed to continue. Any bending after plating is likely to lead to structural modification of the surface and consequently very serious interference with the corrosion characteristics of the metal. Mr. R. H. Clayton queried whether the nitric acid found resulted from the presence of ammonia in the gas. In many cases from 20 to 25 grains of ammonia are present in the gas at the inlet to the purifiers, so it is likely that considerable amounts of ammonia pass forward with the gas stream. Mr. W. W. Townsend maintains that investigation of the gum problem is worthy of the special attention of the General Research Committee, particularly in view of the increasing use of thermostatic control of gas appliances. Mr. Wood's written reply to these and other questions raised during the discussion will be of great interest.

Effluents and Ammonia.

The final item for discussion on Tuesday was the report of the Effluents and Ammonia Sub-Committee, which deals with the biochemical oxidation of the constituents of gas-works liquors in admixture with sewage, the removal of phenols from ammoniacal liquor by distillation, and the manufacture and utilization of ammonium bicarbonate. Experiments on bacteria beds showed that all the substances could be destroyed completely by bacterial action,

The order of increasing difficulty of oxidation is phenol, thiosulphate, catechol (higher tar acids), thiocyanate, and sulphide. The individual constituents of gas-works liquors are not therefore of the same importance where biochemical oxidation is concerned. It would seem that a particularly suitable spent liquor for treatment in admixture with sewage would be that from a crude liquor originating in gas which, while still above the dew-point, is subjected to the action of an efficient tar precipitator, and which is kept free from oxygen until it enters the purifiers. Although such a liquor would have a high phenol content, it would be almost free from higher tar acids, thiocyanate, and thiosulphate. It would therefore be easily oxidized. The ammoniacal liquor from such a sytem would contain, in addition, sulphide, which is difficult to oxidize, but there is no simple method at present either of preventing its occurrence, or of removing it, except by distillation.

In regard to the removal of phenols by distillation, one cannot hope to remove more than a comparatively small quantity of phenol when liquor is distilled to remove ammonia in the most economical manner.

The report describes a method, which has been patented by the Institution, of manufacturing ammonium bicarbonate from crude vertical retort coal gas. This compound is considered a possible alternative to ammonium sulphate as a fertilizer, the chief advantage over the latter salt being that sulphuric acid is not needed for its preparation. This, other things being equal, would mean a considerable economy in ammonia recovery.

The theoretical aspect of the formation of the salt is discussed, and it is concluded that, in order to render possible the deposition of ammonium bicarbonate from crude coal gas, it is necessary either to cool the gas to temperatures much below normal, or to increase either its carbon dioxide or its ammonia content. The latter alternative forms the basis of the process, and the method by which it is effected is to concentrate the ammonia from the whole of the gas into a fraction of it.

Briefly, the process consists of dividing the gas stream at the outlet of the condensers, efficiently de-tarring the fraction to be used in the process, enriching it with ammonia (containing an equivalent amount of water vapour) by distilling into it the ammoniacal liquor produced from the whole of the gas, and passing the mixture through a vessel containing a solution saturated with ammonium bicarbonate. After leaving this absorption vessel the gas, after a preliminary washing, will rejoin the main gas stream before this reaches the scrubbers. The fraction of the gas and the amount of ammonia used in its enrichment will be chosen so that both ammonia and carbon dioxide will be absorbed, ultimately in equal volumes, by the solution in the absorption vessel. This will then become supersaturated with ammonium bicarbonate, of which an amount equivalent to the ammonia absorbed from the gas will be deposited as crystals, which will be separated and dried, and the solution used again in the absorber.

A *Paying Proposition.*

After Mr. Botley had introduced the report, Prof. Cobb explained that the previous day he had visited Rothamsted and saw Sir John Russell and Dr. Crowther (who has been closely identified with the field experiments). Experiments are being carried out to compare sulphate and bicarbonate when applied by the methods usual for ammonium sulphate. Of the ten results so far obtained, seven showed no difference between bicarbonate and sulphate, while three showed appreciable inferiority of bicarbonate to sulphate. Further study is necessary to arrive at a just comparison. Mr. A. L. Holton stated that the dephenolating plant at Partington is now definitely a paying proposition, in addition to the fact that there is a purification, from the oxygen absorption point of view, of 85%. Dr. Key, he said, had pointed out in the report that the phenols were really of little account. To this, Dr. Key replied that he was referring to the treatment of effluents at the sewage works. Phenol is, of course, highly toxic to fish life. Mr. P. Parrish is always interesting. He described himself as a practical man, although a chemist, and he asked whether the report led them any further. To his mind, the one solution of the bye-product ammonia problem is the adoption of central works throughout the country at strategic points where concentrated gas liquor can be converted into ammonia products—not necessarily sulphate of ammonia.

Dr. E. W. Smith pointed out that all who had discussed the report at the meeting—the speakers included Dr. A. Parker, Mr. O'Shaughnessy, Mr. Hollings, and Dr. Pexton—are chemists; and the chemist is not entirely eligible for membership of the Institution. This ought to be redressed. The President replied that neither the Council nor the members of the Institution have any objection to chemists, as chemists, being admitted. "You must bear in mind, however," he said, "that at the present time under the terms of our Charter they are not eligible, unfortunately, and that is a difficulty we have to overcome. We are, however, thoroughly sympathetic, and should like to have the chemists as corporate members of our Institution. No one will be more pleased than myself when we get over the obstacle." On the question of manufacturing bicarbonate of ammonia, Dr. Smith believes that an evaluation of known processes is necessary before large-scale operation is commenced; and this led him to consideration of the administrative problems involved. The Sulphate of Ammonia Federation, he said, used to be a gas and coking industry controlled body; to-day these two industries do not control the Federation. It is, however, vital to obtain the support of the Federation in the sale of bicarbonate. He suggests the formation of a carbonizing Sulphate of Ammonia Federation. An attempt should be made to stand on our own feet. "One of the bitterest disappointments some of us have had in recent years," he concluded, "was the small response which the Gas Industry, through the local Associations, gave to the suggestions of the Ammonia and Effluents Committee, for there were possibilities in centralization of concentrated ammonia works and the ownership by the Gas Industry of the necessary sulphuric acid works." If these two problems were tackled, he is satisfied we should have no loss in connection with the production of sulphate of ammonia. He is also satisfied that there is no administrative collaboration in the Industry to-day.

Altogether the discussion was keen and showed the value of the work carried out by the Committee. A few years ago a great many gas undertakings were in serious trouble over effluents. Thanks to the Committee's work, these troubles can now be solved in co-operation with the sewage authorities. As Mr. Botley said at the close of the discussion, if gas undertakings are in difficulties they should communicate with the Committee.

Mr. West's Film of the Tour.

At the close of the technical business on Tuesday afternoon Mr. Fred J. West put on the screen his film of the Institution tour to Canada and the United States. This film was thoroughly enjoyed by all, and the thanks of the members were voiced by Mr. Tarratt.

Leakage from Horizontal Retorts.

The report by Mr. A. H. Clucas on Leakage in Horizontal Gas Retorts was the first item for discussion on Wednesday morning. The investigation was carried out at the works of the Leeds Gas Department. In the first section of the communication the author discusses the method of estimating the leakage of coal gas through the retort walls by the determination of the depression of the content of carbon dioxide in the waste gases below that in the theoretical products of combustion of producer gas. This method showed that the leakage varied between 2·7 and 0·7 therms per ton of coal carbonized. The pressures at the middle line of retort mouthpieces varied between 0·2 and 0·05 in. w.g. When, by sealing the anti-dips, the pressure was raised to about 1 in. w.g., leakage of coal gas of the order of 15% occurred. After newly-scurfed retorts are charged, the leakage for some little time is of the order of 10%. The author passes on to the determination of the leaky condition of retorts by direct measurement by the method formulated by Mr. T. F. E. Rhead, where cooled waste gases are pumped into a sealed empty retort and the leakage through the retort walls is determined by measuring the rate of delivery and the presure maintained within the retort. Actually, in the Leeds experiments, air was employed. By this method it was possible to compare retorts working under normal conditions in different parts of the retort house, and also to survey the effect of scurfing and the tightening effects of hot patching, wet spraying, and scurf formation. Useful comparisons between retorts undergoing repairs were also made. It is shown that mouthpiece joints are rarely responsible for any large proportion of the leakage existing after scurfing. Hot patching seldom reduced the leakage after scurfing by more than about 25%, and extensive hot patching gave only a slight additional improvement. Retorts were found to be relatively gas-tight when coated with the maximum amount of scurf collected during normal working; this maximum formation represented an accumulation during anything from 80 to 200 days. Scurfing the retorts produced a condition that allowed considerable leakage to take place, and even after hot patching and spraying they leaked extensively. After carbonizing for one day an appreciable reduction in the leakage was obtained, the scurf produced being sufficient to reduce the figure to between one-third and one-fifth that existing before the first coal charge. A marked improvement was obtained after the first day and, in most cases, a period of three to five carbonizing days

reduced the leakage to a value only about double that existing before scurfing. Surveys of complete "scurfing-to-scurfing" periods showed that generally the leakage did not alter to any great extent after the first six to ten days. In a few cases, however, a greater variation was obtained.

The benefits of scurf formation are well known, and, in the case of horizontal retorts that had worked at least 1500 days, it has been demonstrated by experimental results that the scurf layer was the major factor in making them gas-tight. The removal of this scurf made it possible for considerable leakage to occur and at least five carbonizing days were necessary, with a newly scurfed retort, to reduce leakage to the same order as that existing before scurfing. During one carbonizing day, however, sufficient scurf was formed to exert an appreciable tightening effect which was usually greater than the combined effect of hot patching and spraying.

A very thin layer on parts of a retort surface was often observed at the end of a single carbonizing period after scurfing, but at least ten days was required to form a layer that had the appearance of completely covering the retort surface. No doubt, a large portion of the deposition of scurf during the first few carbonizing days takes place within the cracks. The demolition of old retorts, however, has shown holes and cracks of such dimensions that it is difficult to imagine any effective sealing by the deposition of carbon within them. In such cases effective tightening was probably dependent on the formation of scurf layers over the openings.

Cement Spraying.

The author mentions that when spraying was first introduced at the New Wortley Works, very little information as to the most satisfactory methods for carrying out the process was available, and no beneficial results could with certainty be predicted; its adoption was therefore essentially experimental. It was hoped, however, that one of the chief advantages would be to prevent loss of gas by leakage through the retort walls, but the results of the various leakage tests were disappointing in this respect, and no evidence was obtained that spraying produced any appreciable tightening of the retorts.

Benefits were, however, obtained in quite an unexpected direction. After working about 1200 days, the retorts began to give trouble during discharging, particularly in the case of newly-scurfed retorts. These conditions became worse with age, and in course of time it was often necessary to remove some portion of the charge by hand, thus requiring extra labour and adding to the cost of gas production. This difficulty in discharging retorts was an important factor influencing the management in any consideration to let down the plant for either cold repair or re-building.

The spraying of these retorts coincided with a pronounced reduction in discharging troubles, and an attempt was made to ascertain if this could be attributed to the spraying. Observations were therefore made on twelve pairs of retorts, one only of each pair being sprayed. The relative values of "discharging difficulties" for the retorts examined indicated a definite advantage to be obtained by spraying. It is evident that spraying gives beneficial results in that it reduces discharging difficulties with old retorts, and that it is a factor contributing to the attainment of a longer working life.

No certain explanation can be offered for this easing of discharging difficulties, and it must be a matter of some conjecture. The shapes of these old retorts were, generally, very good but the inner surfaces had innumerable cracks of varying sizes. If the coke became moulded into these cracks, and particularly at the bottom of the retort, it would offer considerable resistance to the discharging ram. Although spraying did not fill up these cracks completely, it did reduce their depth and irregularity, and thus the extent of any "keying in" of the coke. In addition, it has been estimated that at least one quarter of the cement sprayed into a retort collected on the bottom as a loose powder; this apparent waste may actually have been the main factor in giving the beneficial results, the powder acting as a solid lubricant.

Effect on the Balance-Sheet.

Mr. C. S. Shapley, the first speaker in the discussion, remarked that, thanks to the work of Mr. Clucas and his collaborators at Leeds, a balance-sheet reflected the savings in £ s. d. As a result of the investigation he is now satisfied that it is economically sound to work retorts which are termed old—after a service of 2200 days. The term old is relative, and what have been called old retorts ought perhaps to be considered middle aged. "The knowledge that the retorts are made tight by scurf and by careful pressure control," remarked Mr. Shapley, "together with the decreased resistance to discharging obtained by spraying, now enables us to work the retorts as long as they are structurally strong enough to withstand the wear and tear of the stoking machinery, or until they offer too much resistance to being discharged. Actually the effect is that the life of the retorts has been lengthened up to 75%." Mr. Shapley gave the results at present being obtained from 27 beds of 8 retorts. Thirteen of the beds have worked 2600 days, six for 2040 days, and the remaining 8 beds are new. The results speak for themselves.

The practice of minimizing leakage from the horizontal retorts at the Beckton Works of the Gas Light and Coke Company was described by Mr. K. C. Mead, who remarked that, whereas Mr. Clucas shows that his retorts take five days to become tight again after scurfing, at Beckton normally the retorts are in good condition again after two or three charges—*i.e.*, 20-30 hours. This is probably due to the different method of scurfing adopted. The retorts at Leeds are scurfed at intervals varying from 80 to 200 days, and presumably are scurfed clean, with the assistance of scurfing tools. The procedure at Beckton, however, is to burn off carbon accumulations at intervals of about 14 days for a period of 10-12 hours. By this method, it is suggested, surface carbon is removed, but the small cracks and interstices in the material remain sealed up. The use of naphthalene after scurfing is practised at Beckton; and tests have shown that the leakage index is reduced immediately thereby to a figure very little greater than that found before scurfing. The saving effected amounts to 0·3 therm per ton of coal carbonized if the differential pressure is $\frac{1}{10}$-in. w.g. Mr. Mead emphasized that efficient working of horizontal retorts can only be obtained by the avoidance of high pressures within the retort and by the maintenance of tight retorts by careful selection and construction of material, careful and regular patching of all holes and cracks, and the presence of a film of carbon upon the retort walls. Dr. S. Pexton also pointed out that, though the presence of scurf on retort walls does materially reduce gas leakage, it is nevertheless of great importance to maintain a minimum pressure difference across the retort walls even when scurf is present.

The query was raised by Mr. G. B. Howarth whether it would be possible to spray a coating of some suitable cement in such a way that scurf subsequently deposited could be removed by the usual methods without disturbing the first layer. Dr. Lessing mentioned experiments he had carried out a quarter of a century ago in a small gas-works. In these he charged new retorts, on being started-up, and blocked-up the ascension pipes. This was continued till a rise in pressure of about 24 in. water gauge was observed. He suggested that the "inner" deposit of carbon so produced was an excellent safeguard against leakage, and that investigations should be made to find out the difference between the inner filling of the retort material and the mere superimposing of an outer layer of scurf.

Refractory Materials.

The other communication for discussion on Wednesday morning was the report of the Refractory Materials Joint Sub-Committee. As a result of the appeal for funds for the work of the British Refractories Research Association made last year, materially larger resources were available which have enabled a more extensive programme of research to be carried out. It has been possible to increase the number of research workers and to add to the equipment of the Laboratories at Stoke-on-Trent. The extent of the work carried out, both in general matters and in special problems of more particular interest to one or other of the subscribing industries, has accordingly been increased.

In view of the increased contributions made by the different industries, and especially by the Gas Industry, alterations have been made to the constitution of the Council of the British Refractories Research Association to give more effective representation to the various industries. The representation of the Gas Industry on the Council is now as follows: Two members of the Council are nominated by the Institution of Gas Engineers, and one member each by the Gas Light and Coke Company and the South Metropolitan Gas Company; in addition, two members are nominated on behalf of the other gas undertakings subscribing to the funds.

Further to increase the intimate working of the British Refractories Research Association with the different industries concerned, a number of Joint Committees of the former with bodies representing individual industries has been formed. So far as the Gas Industry is concerned, the Refractory Materials Joint Sub-Committee has, ever since the formation of the British Refractories Research Association in 1921, acted as the connecting link, but in order to render this more effective and to bring matters into line with other industries, this Joint Sub-Committee has during the past year been reconstructed as "The Refractory Materials Joint Sub-Committee of the Institution of Gas Engineers,

the Society of British Gas Industries, and the British Refractories Research Association." Five of its members are nominated by the Institution, five by the Society of British Gas Industries, and two by the Council of the British Refractories Research Association. In addition, the President and Hon. Secretary of the Institution and the Director and Assistant Director of the British Refractories Research Association are *ex-officio* members of the Sub-Committee.

Consideration has been given to the " Standard Specification for Refractory Materials for Gas-Works," published by the Institution, the last edition of which, issued in 1925, is now out of print. It was decided that a considerable revision of the Specification was now due, and a special sub-committee was appointed, which has drafted a revised Specification; this will shortly be considered by the full Refractory Materials Joint Sub-Committee, representing manufacturers and users.

Turning to the abstracts of work carried out by the British Refractories Research Association, we find that laboratory results with mixtures of fine aluminium powder and finely crushed silica brick or ganister are sufficiently encouraging to merit the trial on a larger scale of the mixture as a hot-patching material for gas retorts. Again, based on the results of preliminary experiments on the packing densities of mixtures of different grades of ground ganister, silica brick batches have been prepared which might be expected to give fired products of approximately minimum porosity and permeability.

Flaking of Retorts.

The factors of major and minor importance which influence the flaking of vertical retorts are summarized in the report as follows:

> The impregnation of scurf into the retort surface, its adhesion thereto, and its elimination during the scurfing operation.
>
> The constitutional changes in the silica in the surface layers resulting from high-temperature scurfings.
>
> The weakening of the surface layer by alkali and other impregnations.
>
> The steep temperature gradients in the retort wall obtaining at the flaking zone during normal working and the chilling effects of intermittent travel of the charge.
>
> The rodding of the charge and of the scurf during the scurfing operation.

The authors of this part of the report—Messrs A. T. Green and F. H. Clews—state that they are not in a position to recommend to the Industry an alteration in the design of retort setting which might react favourably in reducing flaking. It is clear, however, that the scurfing operation demands every consideration. The reduction and careful control of combustion chamber temperatures during scurfing, the control of the amount of air admitted to the retort during this operation, the elimination of rodding, and the adoption of a scurfing schedule conceived on the basis of adequate experience should materially help to reduce flaking.

There can be little doubt that the careful control of combustion chamber temperatures to suit (*a*) the type of coal to be carbonized and (*b*) the scurfing operation will materially help in keeping down flaking troubles.

It is evident that the refractory material in the flaking zone is required to resist, among other things, the severe stresses and the high temperature resulting from the scurfing operation. Consequently, the mechanical properties of such refractory materials at high temperatures are involved. Again, if the adhesion of the scurf to the refractory is a factor, and if this adhesion depends on the penetration of scurf into the retort face, then the permeability of the refractory materials must be considered.

Views at the Meeting.

This subject of flaking in retorts constituted the hub of the discussion. Mr. Frank West said that both users and manufacturers of refractories must collaborate to cure the trouble—the former by carefully controlling the scurfing operation; the latter by adjusting the physical properties of the products to withstand controlled scurfing operations. Referring to the recent tour of the Institution to Canada and the United States of America, Mr. West remarked that the knowledge gained will be reflected in the future work of the British Refractories Research Association, and that the Institution will benefit in the long run by the special researches undertaken by the Association. Mr. J. Mitchell, of Leicester, maintains that the flaking of continuous vertical retorts cannot always be attributed to the refractory material, but is in many cases due to faulty scurfing and lack of care in ensuring uniformity of temperature throughout the length of the retort. Combustion chamber control can do a great deal to overcome the trouble. Mr. Copp's opinion is that flaking is a difficulty largely of a mechanical nature. We get impregnation of scurf in the interstices of the retort material. The layer may possess a different coefficient of expansion from that of the refractory material, so that strains are set up every time there is a change of temperature. He pointed out that flaking does not take place at an even rate. As the brickwork becomes thinner, the flaking becomes less. Mr. C. H. Carder does not regard periodic or intermittent chilling of the retort as a major cause of flaking. He instanced an installation of 36 vertical chamber ovens which were in constant operation for 2297 days. They worked on 12 hours' carbonization and 3 hours' steaming, so that the alternation of an entirely cold charge was frequent, and persisted over a very long period without giving any indication of flaking or spalling. Careful attention to the scurfing operation will largely reduce the trouble. Mr. Carder does not consider high temperatures, *per se*, as the cause of flaking.

Free-Burning Gas Coke.

The last technical item of the meeting was the communication by Dr. E. I. Lloyd, Mr. F. Bell, and Mr. H. J. Hodsman on the Behaviour of Cokes in the Open Grate. Perhaps the most interesting part of the report is that dealing with the treatment of gas-works coke to render it readily ignitable. There persists the demand for a fuel which can be ignited with " wood and paper." It has been generally assumed that such a fuel must contain a considerable proportion of volatile matter and be carbonized at low temperatures if it is to be adequately " combustible."

In the Institution Gas Fellowship Report (1927) it was shown by Dr. F. J. Dent and Prof. J. W. Cobb that differences in " combustibility " of cokes appear to become negligible above 800° C. The considerable differences commonly recognized could be detected only below a red heat. This conclusion has not received the attention it merits. It implies that a fuel which is to be adequately " combustible " and easy to ignite needs to have these qualities only on the surface. When the fuel has attained a red heat, the character of the interior is relatively unimportant. Indeed, in point of heating efficiency, it has been shown that the advantage then lies with the high-temperature cokes.

Repeated attempts have been made to impart this ease of ignitability to coke by treatment with oil, creosote, and tar, but a little experience reveals the futility of such a process.

In the Laboratory of the Fuel Department at Leeds the modification of the surface of gas coke has been made the subject of investigation by Mr. G. A. Thompson, Mr. Bell, and Dr. Lloyd. It would seem that a film of coal itself is nearly ideal for the purpose. Of the alternative methods of giving to the coke a skin of coal, the best so far found has been to spray the coke simultaneously with coal dust, using hot road tar as an adhesive. The technique, described in the report, is simple, and a satisfactory product with sufficient skin to raise the volatile matter to 4% is clean to handle, and practically odourless.

The treatment makes a remarkable change. A vertical retort coke with a skin of coal can be ignited as easily as a low-temperature coke and will burn in an ordinary grate. The reactionary who clings to the traditional " wood and paper " can light it like raw coal. If anything, it burns up more quickly than coal and the low-temperature coke with which it has been compared.

A vertical retort coke under favourable conditions is thermally the most efficient fuel for an open fire. This quality is only slightly impaired by the treatment. Consequently a coke activated with coal combines the easy ignition of coal and low-temperature coke with the high effectiveness in use associated with high-temperature coke. The only apparent disadvantage is the proportion of smoke for a few minutes during lighting and replenishment. But in the aggregate the quantity of smoke can only be a fraction of that from raw coal. This would largely disappear if a smokeless adhesive could be found.

The view is advanced in the report that those interested in the sale of carbonized fuels should not passively conform with the prevailing fashions in fireplace construction. The popular view that the modern barless grate possesses any superiority in efficiency has no foundation. It is better than what it replaced, and its popularity is largely due to its simplicity of construction and æsthetic appeal. That so crude an appliance serves as a tribute to the excellence of the house coal available in this country rather than to any special merit of grate construction. Therefore, although the tendency has been for investigators to seek a product adapted to existing grates, there are good

reasons for pursuing the opposite course of educating the consumer to install appliances suitable for the fuel.

The process of low-temperature carbonization represents efforts to make a product which can be burnt in a grate designed for consuming coal. Experience has shown that such fuels can be produced and have already acquired considerable popularity. So far, however, they have not been marketed at prices which encourage their substitution for raw coal, presumably owing to high costs of production.

If the consumer will install suitable appliances he can at once widen his choice of fuel without paying a higher price for it. Indeed, in view of the higher thermal efficiency of coke fuels, he will lower the cost of the effective unit of heat. Moreover, the appliance, if incorporating a gas burner for ignition, will save domestic labour. Chimney sweeping will become unnecessary. The extension of such appliances would provide a considerable use for gas. If it became standard practice in a city of the size of Leeds to light fires with gas, there would be a new daily load of at least half a million c.ft.

"A Confession of Weakness."

Introducing the communication, Mr. Hodsman said that, judging by the literature, it might be supposed that the ideal is a fuel which can be ignited with " wood and paper." Apart from the fact that this is a vague standard, incapable of measurement, it may be doubted whether this criterion will retain importance. Sooner or later it may occur to makers of coal grates and those interested in the sale of coal that it is not only more convenient to light a coal fire with gas, but demonstrably cheaper. A gas burner for ignition would then become a standard fitting on solid fuel appliances in an area of gas supply. A fire without one would appear as strange as a motor car without a self-starter.

The point was made by Mr. Gibson that there is no special need for the Gas Industry to adopt low-temperature carbonization, with its low gas yield and higher costs. Gas cokes are superior to low-temperature cokes in output of heat, and they last longer. Mr. Gibson expressed surprise at the large quantity of gas used for ignition of the cokes dealt with in the report—a matter of 12-14 c.ft. At Liverpool the special domestic coke is not allowed to go out for sale unless it can be ignited with 4 c.ft. of gas. As for the use of a gas burner for ignition—is not this a confession to the general public that coke is not as good as coal? The Gas Industry can provide fuel for the domestic grate which is smokeless and easily ignited. Gas burners could be put into new grates, but the fact remains that existing grates have to be catered for. Mr. Gibson suggested the drawing-up of a standard specification for high-temperature domestic coke for the open firegrate.

The next speaker, Mr. R. B. Clayton, gave a short account of the manufacture of a low-temperature fuel in coke ovens by a new process which has been patented, and suggested, in regard to the use of gas coke, that greater attention should be paid to the grates themselves.

A highly interesting contribution was made by Mr. F. Firth, of Leeds, who described investigations made to ensure a supply of coke which should be silent in burning and free from " fliers." Noisy combustion and " fliers," he said, are determined by the method used for cooling the coke after carbonization, and are independent of the particular coal carbonized or the shale or moisture content of the coke. Shock quenching the coke with water produces noisy burning coke; on the other hand, cooling with inert gases or air produces a silent burning fuel. In one of the experiments a parcel of air-cooled coke was allowed to stand in a bucket covered with water for 12 hours, and then allowed to drain to the point where the coke retained its moisture without dripping. On its being used to replenish a fire in the open grate, no noise or " fliers " were observed, and the fire actually burned appreciably brighter.

The work described by Mr. Hodsman, said Prof. Cobb, has been proceeding for some years in the University of Leeds. It has been based upon the assumption that if coke is to find a ready market it must be efficient and attractive when burning in the open grate. He stressed the point that the endeavour to meet these requirements is being made by the coke oven and low-temperature carbonization industries, as well as by the Gas Industry, and it is not a matter which can be neglected without serious loss.

Speaking as one outside the Gas Industry, Mr. A. F. Dufton, who referred to an article he contributed to the " JOURNAL " in 1931, stoutly championed gas coke as a fuel for the open firegrate. " I hold," he observed, " that gas coke is the ideal fuel for the open grate, and I contend even more strongly that gas is not the ideal lighter for coke. I have burned no coal in my grates for the past six years." Dr. G. E. Foxwell believes that the Gas Industry might well employ more Leicester and Warwickshire coals to blend with coking coals, and that much greater use of washed coals should be made than at present. Mr. Holton attributes the success of the sales in Manchester of high-temperature coke for domestic purposes to the fact that the water content is eliminated as far as possible. No domestic coke goes out of the works with a higher water content than 1½%. " I know," he said, " this brings down the returns under ' coke,' but I suggest that those who are selling water are doing the Industry very great harm indeed." Mr. Holton intends to try spraying the coke at the bottom of the vertical retort with a colloidal solution of oil and powdered coal.

Report on the Institution Tour.

Mr. Tarratt then read a report on the tour of the Institution to Canada and the United States of America. This is published on later pages. Mr. C. Valon Bennett said that, though he was not fortunate enough to accompany the party to Canada and America, he had read all that had appeared in the Technical Press, and had spoken to many who did take part in the visit; and everyone had told him what a wonderful leader Mr. Tarratt was. There were two items in the report which struck him forcibly. One paragraph said: " Every member felt his responsibility and lived up to it, doing his utmost to uphold the prestige of his own country by a ready recognition of the merits of the country in which he found himself, and not forgetting that if he could learn he could likewise teach." Then at the end of the report it was stated: " Many lasting friendships were made and even closer relationship will ensue to our mutual advantage between the Canadian, American, and British Gas Industries." Mr. Tarratt had been most modest in his remarks and had made no reference to himself, but he (the speaker) felt that it would be lacking on his part if in thanking Mr. Tarratt on behalf of the Institution, he did not say that everyone felt that the success of the visit was largely due to their President.

The President then reported that the 71st Annual General Meeting of the Institution will be held in London on June 5, 6, 7, and 8, 1934; that the 2nd International Gas Conference will take place in Zurich on Sept. 4 to 7th, 1934; and that the 6th Autumn Research Meeting will be held in London on Nov. 6 and 7, 1934.

Omnibus Vote of Thanks.

Mr. G. M. Gill said it was his pleasure to propose a hearty vote of thanks to a large number of bodies and persons in connection with the Research Meeting. There were first of all the University of Leeds and the Livesey Professor and the Research Chemists, assistants, and staff, for the immense amount of work done in connection with the Research Reports. They also wished to thank the authors of the Reports, and the undertakings, organizations, and gentlemen conducting education or research work for the Institution, or providing facilities therefor. There were also the Chairmen and Members of the Gas Education Committee, the District Gas Education Committees, the Board of Examiners, the General Research Committee and its Sub-Committees, the Technical Committees, and the Joint Research Committee of the Institution and Leeds University. Next they wished to thank the Institution of Mechanical Engineers for the loan of their premises for the holding of the meeting. He would also like to include in the vote of thanks Mr. Alexander—their Secretary—and his staff. Finally, he must mention their President, whom they were so glad to see back with them again after the visit to Canada and America.

The vote of thanks was cordially given without the formality of being seconded, and the meeting terminated.

Autumn Research Meeting Luncheon

Among those present at the Autumn Research Meeting Luncheon, which was held at the Savoy Hotel on Tuesday, Nov. 7, were Mr. A. E. L. Chorlton (President, Institution of Mechanical Engineers), Mr. P. V. Hunter (President, Institution of Electrical Engineers), Rt. Hon. J. R. Clynes, Rt. Hon. Lord Askwith, K.C.B. (President, Institute of Arbitrators), Mr. J. F. Ronca (Director of Gas Administration), Sir Robert Robertson, F.R.S. (Government Chemist), Mr. E. M. Severn (President, Association of Public Lighting Engineers), Dr. F. S. Sinnatt (Director of Fuel Research), Mr. H. E. Bennet (Chairman, Society of British Gas Industries), Prof. W. A. Bone, F.R.S., Prof. C. V. Boys, F.R.S. (Gas Referee), Dr. H. T. Calvert (Director of Water Pollution Research), Mr. Reginald G. Clarry, M.P. (Chairman, British Road Tar Association), Sir Christopher Clayton (Chairman, Liverpool Gas Company), Prof. J. W. Cobb, Dr. H. G. Colman, Mr. Harold E. Copp, Dr. E. M. Crowther (Rothamsted Experimental Station), Mr. R. W. Edwards (Chairman, Gas Companies' Protection Association), Mr. E. C. Evans, Dr. Margaret Fishenden, Mr. E. J. Fottrell (National Gas Council), Mr. R. E. Gibson, Mr. W. Grogono, Sir Harold Hartley, F.R.S. (Chairman of Fuel Research), Mr. H. C. Honey, Major Geoffrey H. Kitson, Mr. W. E. Mordecai (President, Coke Oven Managers' Association), Dr. E. W. Smith, and Lt.-Col. H. W. Woodall.

The PRESIDENT (Mr. F. P. Tarratt) was in the chair, and, proposing the toast of "Our Guests," said that in this work of research for the general benefit of the country at large the Institution of Gas Engineers endeavoured to pull its full weight, and so did other bodies. But during the visit of the Institution to Canada and America, opportunity had been afforded of inspecting various institutes and research laboratories in those two countries, and they provided some food for thought as to whether we were doing all we might in this country. Everything possible should be done to throw light on the many mysteries that require solving—and which would be ultimately solved—and to prove what is the actual truth. He coupled with the toast the name of Mr. Chorlton, and, remarking that many members of the Institution of Gas Engineers were corporate members in some form of the Institution of Mechanical Engineers, added that in his opinion—with all due deference to chemists—the mechanical engineer is more needed to-day than ever he was. He felt that gas undertakings were occasionally rather lacking in not selecting at times members of their staffs who were out-and-out mechanical engineers. In a great many instances the mechanical engineer on a large works could contribute materially to the success of the undertaking from the manufacturing and engineering point of view. The Institution of Gas Engineers was only too pleased to be associated with the mechanical side.

AN ENGINEERING HOUSE?

Mr. ALAN E. L. CHORLTON (President, Institution of Mechanical Engineers), responding, said he regarded the Institution of Gas Engineers as one of the grandchildren of the Institution of Mechanical Engineers, one of the sons of the second generation of the old Institution originally started by George Stephenson. No doubt it was a sign of the times when the Institution of Gas Engineers was established, because when that was done everything seemed to be of a centrifugal nature—*i.e.*, there was a splitting-off one from the other. To-day these forces were reversed, and were having the effect of bringing the various classes of engineer together again. The Institution of Gas Engineers was doing splendid work in research, and everybody must be agreed that research was one of the most necessary things, if we were to return to anything like the state of prosperity we desired. Would it not be possible for all those who practised some form of mechanical engineering to have in the near future a big research gathering in which they would turn over their ideas, and see if they could not collectively for all branches of mechanical engineering put forward something which would be of real national value, and would help the whole of the country, as well as themselves. One difficulty at the present time was that, not only was their work a good deal dissociated, but they did not even live in the same street or in adjacent houses, and if there had been one great house in London in which all the various Institutions were accommodated, this would have been of great assistance. This idea had been put forward many times, but it had never advanced to more than the first stage. Was it not possible, however, when the Institution of Gas Engineers was considering the question of headquarters, to have in view the possibility of at any rate establishing them near the headquarters of the Institution of Mechanical Engineers. In that way it should be possible to provide common amenities by way of library and general equipment of meeting rooms, committee rooms, &c., to a far greater extent than existed at the present time, with all the Institutions operating independently, and often a long way from each other.

INTERNATIONAL CONFERENCES.

Another matter of considerable importance was the holding of so many international conferences abroad. It was the fact that other countries had been more alive to the advantages to be gained from international conferences, and so it was we found the headquarters of so many of them in Paris or somewhere on the Continent. Only the other day he had received a letter, as President of the Institution of Mechanical Engineers, from Italy, showing how research development was going to be carried on, and asking for our collaboration. There was no reason why we should always be helping other people; they should sometimes come here and help us. He suggested, therefore, that one of the objects of engineers getting together should be to form a centre so that international conferences on engineering should be held more frequently in this country. Then there was the need for deliberately going out to discover new industries in order to provide employment, which was one of the most difficult problems at the present time. After all, engineers were trained with this specific object in mind, and when it was remembered what wireless had done and also the tremendous development in motor-cars, and some other industries which were not strictly necessary, it would be seen that it was possible by establishing new industries to employ all those who were now out of work. Gas Engineers, of course, could not hope to do it by themselves, but they could join in with others, collectively aiming at that object. This he regarded as the most important question of the day, and he offered the suggestion for serious consideration.

"GAS FOR THE LAND."

Referring to electricity and the grid, Mr. Chorlton said that the word "grid" was a modern form of expressing he hardly knew what, but at any rate it was a very useful term to the ordinary man to absorb as indicating a widespread supply. Why, therefore, had the Gas Industry not stepped out in the same way? Must the Gas Industry give to the electricians the advantages of technical education of a generation ahead, or was it that the Gas Industry quite frankly did not believe in it? In other countries the supply of gas on a more or less "grid" system had gone ahead, and he believed that if a similar scheme were adopted in this country there would be greater advantages from it than could be shown in any other country. If we were going to have agriculture developed in the way we had been told, and in which a large proportion of the people would go back to live on the land, were gas engineers not going to supply these people with gas? He hoped his friend Mr. Clynes would support him in the House of Commons on the question of the necessity for carrying gas about the country as the population moved. Energy could be transmitted from one part to another in various ways, and he believed that heat could be most

efficiently transmitted in the form of gas. He admired the way in which the Institution of Gas Engineers was tackling the question of research, and he wished them more money, more facilities, and more energy to do it.

Mr. P. V. HUNTER (President of the Institution of Electrical Engineers), in a witty speech proposing the toast of "The Institution of Gas Engineers," said he hoped that this luncheon would be one of the opportunities for bringing the two Institutions closer together. He had learned more about the Gas Industry than he had known previously from a number of beautifully got up brochures which had been sent him by the Secretary of the Institution of Gas Engineers. What had appealed to him was that the Gas Industry was somewhat larger than the electrical industry (its consumption of coal was larger than the consumption of coal in the electrical industry), and that the Gas Industry must be extraordinarily efficiently run because there were only 1500 members to run it, whereas it took 15,000 members of the Institution of Electric Engineers to run an industry which was not so big. [Laughter.]

Commenting on the information supplied with regard to examinations, Mr. Hunter said he would pass that over quickly, as he felt it was entirely out of his province; but he noticed that the examiners considerately stated that the candidates need only attempt two of the questions. At the same time, it seemed to him that complete understanding of even only one of the two called for a very high degree of knowledge on the part of the candidate. However, what interested him most of all were the descriptions of the research work being carried out by the Institution, though so far as he could gather most of it was directed to making it more difficult than ever for the electrical engineer to exist. [Laughter.]

RIVALRY OF A FRIENDLY NATURE.

Mr. RALPH E. GIBSON (Immediate Past-President), responding, thanked Mr. Hunter for the happy way in which he had proposed the toast. It was very fitting, he said, that this toast should have been proposed by the President of the Institution of Electrical Engineers, for those in the Gas Industry looked upon electricity as a sister industry, notwithstanding the fact that they sometimes disagreed. Everybody appreciated the services that electricity was rendering to the nation, and the Gas Industry was aware that electricity had many applications for which gas was unsuitable, just as, he was sure, Mr. Hunter realized that for other purposes gas was the more suitable. If the two industries were competitors in certain directions, their rivalry was of the most friendly nature. In point of fact, they had many things in common. So far as research work was concerned, they had good reason to be proud of the Institution for the active policy it had pursued. Mr. Canning, he believed, was the first to point out, not long ago, that the first organized research in the Gas Industry was undertaken in the year 1882, when a report was presented on the effect of condensation on the illuminating power of gas. Since then—and especially during the past twenty years or so—the Institution of Gas Engineers had been responsible for more and more research work upon all kinds of subjects, to the great benefit of the Industry and the community it served. The position that the Gas Industry now held was due in no small measure to the advances made in scientific and industrial research, and efforts in this direction should not be relaxed, for it was only by research that we could hope to establish higher standards of efficiency and in that way to increase the usefulness of the Industry to the community. Great stress was being laid to-day on the importance of salesmanship, and rightly so; but in his opinion the development of the technical side was of greater importance, and even the salesman was all the better for having some technical knowledge. Reference had been made by Mr. Chorlton to international gatherings in foreign countries, and it was perhaps interesting to note that there was to be an International Congress of Chemical Engineers in 1935 in London. The Institution of Gas Engineers was taking an active part in the preparations for that congress. In regard to Mr. Chorlton's mention of the need for a gas grid, there was, of course, a gas grid on a small scale in South Yorkshire, and it was being developed; but the Gas Industry was in the unfortunate position of not being able to command Government assistance, as their friends in the electrical industry could do.

The Right Hon. Lord ASKWITH (President of the Institute of Arbitrators), proposing the toast of "The President," said he understood that there were no industrial disputes in the Gas Industry, and he congratulated them on that fact.

The toast was drunk with hearty enthusiasm, and the PRESIDENT, in acknowledgment, said that, with the loyal support of the members and of his Chairman and Board of Directors, he hoped that the Institution would make still further progress during his year of office. He specially thanked his Chairman and Board for the manner in which they had supported him when he informed them of the proposal to elect him as President of the Institution. They told him to go ahead, and at the same time they promised him their fullest support.

Mr. Tarratt's Report on the Visit of the Institution to Canada and the United States

Adequately to report the visit of the Institution of Gas Engineers to Canada and the United States of America from Sept. 8 to Oct. 16, 1933, would demand, if justice were to be done to it, a dissertation occupying very much more time than is available. The intention is to report the visit formally and to afford you and me the opportunity of thanking in General Meeting those who were responsible for the enterprise. Fully descriptive illustrated accounts of the visit, and comment thereon, have been, and will continue to be, published in the "GAS JOURNAL" and the *Gas World*. I would commend these to your examination when you can sit down quietly and study them.

I do not propose to endeavour publicly to express any opinions on, or draw any conclusions from, what we saw; first, because on the voyage home we appointed a Committee to determine, and it is a problem fraught with difficulties, if an official account of the visit could be given; and, secondly, because no individual is entitled to broadcast his views on a country in general or an industry in particular, based upon the glimpses he had of it and its people during a stay of three weeks.

That we were greatly impressed I can say; that we learnt much we all agree; that our undertakings and interests in the Gas Industry will benefit from the experience we were afforded we shall have no difficulty in demonstrating, and that we wish to go again, and that my fellow members should visit these great countries, is certain.

We were a very manageable party of exactly sixty, which included thirteen ladies. There was no aspect of the various, specialized interests in the British Gas Industry which was not ably represented, and I could not have wished to lead a better team. I use the word "team" advisably, because whatever success we met with in the eyes of our hosts, was largely due to team work. Was it not the largest official gas delegation ever to have left the shores of this or any other country? Every member felt his responsibility and lived up to it, doing his utmost to uphold the prestige of his own country, by a ready recognition of the merits of the country in which he found himself and not forgetting that if he could teach he could likewise learn.

If arduous, the procedure for us in each of the cities we visited was simple. We were met by a Reception Committee on arrival, shown everything of gas interest that could be seen in the allocated time, entertained at luncheon or dinner and returned to the train to travel, by night or day, to the next place in our ten-thousand-mile itinerary. Oddly enough we completed the tour in good health, largely due to the excellence of the organization, which conserved our energy by sparing us most of the evils of travel, such as the booking of hotels, the paying of bills, the taking of railway tickets, and the looking after baggage.

We visited and, in most cases, stayed at Quebec, Montreal, Ottawa, Toronto, Hamilton, and Niagara in Canada, and at Detroit, Chicago, Cleveland, Pittsburgh, Washing-

THE PRESIDENT.

F. P. TARRATT, M.Inst C.E.

Mr. F. P. Tarratt was trained under the late Alfred Colson, M.Inst.C.E., at Leicester, and appointed Engineer and Manager of the Gas Department at Darlington in 1898, taking up the position of Chief Engineer with the Newcastle-upon-Tyne and Gateshead Gas Company in 1921. During the period he has been with this Company they have taken over the Walker & Wallsend, the Chester-le-Street, and the Tynemouth Undertakings. He holds various official positions in connection with the National Joint Industrial Council for the Gas Industry, the Federation of Gas Employers, the National Gas Council, and the North of England Gas Managers' Association.

ton, Baltimore, Philadelphia, New York, and Boston in the United States of America.

What was Seen.

We saw gas produced in horizontal retorts, vertical retorts, various coke oven installations, and in water gas and oil-gas plants. We saw many natural gas fields, and witnessed demonstrations of the operations thereon. We saw the mixing of most of these gases for distribution. We inspected the end of a natural gas pipe line one thousand miles in length and the largest waterless gasholder in the world. The distribution, utilization, and commercial sides of each gas undertaking were visited. We noticed magnificent showrooms, extensive office mechanization, elaborate selling and service organizations, a large refrigeration load added to a larger central heating load, pressed steel enamelled cookers, little demand for gas fires, an absence of gas lighting, and the frequency of joint financial control of the electric and gas undertakings. We visited the factories of the manufacturers of gas plant and appliances, noting in the latter the concentration on mass production methods and the finishing of everything in attractive surfaces and colours.

Wherever there was special reason so to do, we visited outstanding plant of technical and commercial interest not within the Gas Industry, such as the great Canadian hydro-electric power stations, the International Nickel Works at Port Colborne, the Ford Motor Works at Detroit, and steel rolling mills and the research laboratories of the General Electric Company at Cleveland. Similarly we inspected such Institutions as the Laboratories of the American Gas Association at Cleveland, the Carnegie Institute, and the Mellon Institute of Industrial Research at Pittsburgh, and the Gas Engineering Department at the Johns Hopkins University at Baltimore.

At the 26th Canadian Gas Convention, which was held in Ottawa under the able Presidency of a Scotsman, Mr. Hugh McNair, of Winnipeg, I gave an address on "The Progress of the British Gas Industry," while Mr. A. T. Green read a paper on "Research and Refractory Materials." I had the honour of presenting, in the name of the Institution, a suitably inscribed silver salver to the Canadian Gas Association and of placing a wreath from the Institution on the National War Memorial at Ottawa, whereat a reception was given to our party by the Governor-General and Lady Bessborough at Government House.

At Chicago we participated in the International Gas Conference and the 15th American Gas Convention and visited the great Chicago Centennial International Exposition. The former was held under the distinguished Presidency of an Englishman, Mr. Arthur Hewitt, of Toronto. I had the privilege of presenting at the opening of the Convention, the silver salver given by the Institution to the American Gas Association.

The American Gas Association is organized into a Department and six Sections, being the Natural Gas Department and the Accounting, Commercial, Industrial Gas, Manufacturers, Publicity and Advertising, and the Technical Sections. At its Conventions the Association meets in General Session in the morning and in the afternoon each Section holds its own meeting. To ensure adequate British participation in each of the Sectional Meetings, a member of the Institution was appointed as Leader at each Sectional Meeting. We were able to play our part in the discussions, at which many members of our party spoke, in addition to which the following British Papers were presented and discussed:

In General Session:

"The Gas Industry from the British Standpoint." By Frank P. Tarratt.

Before the Accounting Section:

"Meter Reading and Collecting of Accounts; Describing Methods Employed by the Portsmouth Gas Company, England." By Thomas Carmichael.

Before the Commercial Section:

"The Commercial Development of the Gas Industry in Great Britain." By T. P. Ridley.

Before the Industrial Gas Section:

"Watson House—An English Research Centre." By C. A. Masterman.

Before the Publicity and Advertising Section:

"Publicity and Industry." By A. P. Ryan.

Before the Technical Section:

"The Preparation of Coke for the London Market." By F. M. Birks.

Before the Convention concluded I invited the American Gas Association and the Canadian Gas Association to visit England for the 72nd Annual General Meeting of the Institution in London in June, 1935, and I know that, if economic conditons permit of the invitation being accepted, the entire British Gas Industry will support our President at that time in arranging a Programme which will prove both enjoyable and instructive to our distinguished visitors.

At Washington we were received by the British Minister at the British Embassy, after which it was my duty to place a wreath from the Institution on the grave of the Unknown Warrior at Arlington, in the presence of our hosts, the members of our party and of the twelve members of the delegation from the French Gas Association, who joined the British party at Montreal and continued with us to New York, whereat we spent three crowded days before concluding our visit with a short stay in Boston. Abroad the "Georgic" on the way home, the participants in the visit graciously presented me with a silver loving cup, and the Secretary with a silver salver. We shall never forget this generous gesture.

The visit was an unqualified success from every aspect, and I do not hesitate to say that our Canadian and American colleagues have said the same thing from their points of view. Initiated and organized by the Secretary of the Institution (Mr. J. R. W. Alexander) in the closest collaboration with the Managing Director of the American Gas Association (Major Alexander Forward) and the Secretary-Treasurer of the Canadian Gas Association (Mr. G. W. Allen), facilitated by the Council of the Institution and generously supported by the American Gas Association and the Canadian Gas Association in co-operation with the gas undertakings of the cities we visited and of many energetic hosts and hostesses, the adventure deserved and rightly achieved success. Many lasting friendships were made and even closer relationship will ensue, to our mutual advantage, between the Canadian, American, and British Gas Industries.

Tenth Report of the Gas Education Committee—1932-33

Sir FRANCIS GOODENOUGH, C.B.E. (Chairman of the Committee): I have much pleasure in presenting the Tenth Annual Report of the Education Committee, and I say that in no formal way, because it is a very real pleasure to point to the steady progress that is being made in the development of education in the Industry. It is not a good habit in any progressive business to be always looking back and pluming oneself upon the progress made, but there are occasions when looking back gives encouragement for looking forward, and I think the Report now before you does give us that bird's-eye view of the progress made in the past ten years which is gratifying to us all and at the same time encouraging for the future. When you realize that the number of students presenting themselves for examination has increased from 60 in 1924 to 417 in 1933, you get a real measure of the progress that has been made, and when you realize that the number of approved centres has increased during that period from 11 to 43, you get another measure of our progress. In that time the scheme has been twice revised, and the regulations for 1933, now published, and which form the basis of the scheme, I think represent a very great advance on anything that has been published before. I hope they represent, not finality, but a stabilization, at any rate for a good many years to come.

We are very much indebted to the Revision Committee for its valuble work in overhauling the scheme, and I want particularly to express my thanks to Mr. Terrace for the help he gave on that Committee and which he has given me all through in the work of the Education Committee. As you know, Mr. Terrace has retired, but, unfortunately, his health has not been too good, but I am very thankful that it is better now than it was. He has devoted himself to educational work in the Industry, in a way altogether beyond praise.

I should also like to emphasize the value to the Industry of the short courses for teachers, organized by the Board of Education annually for the past six years, for the improvement of the teachers' qualifications to teach. The teachers are all practical, technical men whose training has been in the technics of the Industry rather than in the technics of teaching, and the courses that have been organized so enthusiastically and conducted so efficiently by Mr. C. H. Creasey, of the Board of Education, have been of very real value from the point of view of the students and of the Industry they serve.

I just want to mention that Mr. A. Abbott, C.B.E., M.A., who served us on the Committee for so many years to such advantage, has not left the world of commercial education. He is acting now as Hon. Secretary of the British Association for Commercial Education, and one is always able to confer with him unofficially on any point connected with commercial and technical education in relation to the Industry. That is of very great value to a Chairman of the Committee.

Then I want to emphasize the point made in the Report that students should not readily be granted exemptions prior to examination. Exemption from the whole or part of the three years' course for the ordinary grade certificate is not necessarily in the students' best interests; neither is the taking of the final examination before the candidate is fully prepared. Some candidates, and, indeed, some engineers under whom they may be working, are sometimes in too great a hurry to get certificates. A man wants not merely certificates but real qualifications for his job and for promotion in that job, and it is in the best interests of the student that his preparation for examination should be so thorough that not only is he able to obtain his certificate, but is properly prepared with intellectual knowledge and the capacity to apply his knowledge. I am sure you will agree that the Education Scheme of the Industry is designed for the preparation of a man for his life, and for his livelihood, and not merely for the taking of certificates. We are glad to congratulate those men who have taken these certificates and have earned their diplomas, and feel that they have been really thoroughly prepared for the examinations for which they have sat.

I beg to submit this Report for your consideration.

VALUABLE WORK.

The PRESIDENT: I should like to take this opportunity of thanking Sir Francis for the excellent Report he has presented on behalf of the Education Committee. If one reads it through carefully one appreciates at once the valuable work that is being done. We, as members of the Institution, fully appreciate that it is already reflected in the applications that we have received from candidates for membership. It enables us to sort out these applicants with very much greater care and without injustice to anyone. Any person who is entitled to membership of the Institution we can place in his proper class of membership without feeling that we have done any injustice to anyone else. We feel that this education scheme is one of the very best things that could possibly have been developed. I should like to make special reference to the work of the local centres, which I feel constitutes the heart of the whole concern. If we did not carry them with us, the work in London would be more or less negligible, or futile.

Col. W. M. CARR (Junior Vice-President): The Report which is before us, while it is brief, shows that substantial progress has been made during the past year. As a member of the Gas Education Committee, it is with some diffidence that I take part in this discussion; the Gas Education Committee, being a large Committee, very wisely leaves the bulk of the work to a most efficient and small Gas Education Sub-Committee, and it is to that Committee that we owe our thanks for this excellent Report. Under the leadership of Sir Francis Goodenough, with the assistance of Mr. Terrace and the able support of Mr. Creasey, the work is a model for any Institution; and I feel that our thanks are increasingly due to the Board of Education for the support that we have invariably received from Mr. Abbott, who retired last year, and from our friend Mr. Creasey. I would like to refer to the Report of the Board of Examiners, and to the wonderful voluntary work done by that Board. We are inclined to take such work very often without mention, but there is no better work done for this Institution than the work of those mostly very busy men who have been willing to devote their time to benefiting the juniors who are coming forward, and we should be lax if we did not stress on this particular occasion, when this Report is before us, how much we appreciate what they have done.

LESSONS TO BE LEARNED.

I think there are one or two lessons to be learned from the Report of the Board of Examiners. In regard to the Ordinary Grade Certificate in Gas Engineering, the Examiners state that: "The standard of the work submitted by the external candidates was very fair, but the sketches continue to be only moderately good. A large proportion of the candidates appeared to have no knowledge of photometry." Again, with reference to the Higher Grade Certificate in Gas Engineering, they say: "It is evident that the question of coals is still receiving insufficient attention, and the methods of testing with which candidates appear to be familiar are out-of-date. Most of the candidates had a good knowledge of routine and process working and testing, but the underlying principles were only very vaguely appreciated." I am going to suggest that that is not a reflection upon our instructors and upon our schools, who are responsible for the education of our candidates, but that it is rather a reflection upon us who are the responsible administrators of gas undertakings and who are responsible for administering and looking after the training of the juniors within our own works.

Are we providing sufficient facilities for the all-round training of the juniors within our own works? Are we considering each of our juniors as he comes along? Are we ensuring that they spend sufficient time in the drawing office? The fact that the sketches continue to be only moderately good appears to show that we are not. Are we ensuring that they spend sufficient time, not only in the general works laboratory, but in the fuel laboratory as well? There, again, I suggest the Report of the Examiners shows that we are not. I do feel that we should consider this question of training in our works, what we can do to put before our members definite lines which they might follow in the training of juniors. I know that in small works it is not always easy, but I am of the opinion that in any works it is possible to give facilities to your technical staff if you wish to make them of the greatest value to yourself and the Industry; it is that practical experience which counts. Important as lectures are, important as personal study is, nothing can replace in value that practical experience gained by the execution of work in the undertaking itself.

The question as to the amount of time that should be spent by a junior in the drawing office, in the laboratory, on the works, and on the distribution side is of the utmost importance. Here, again, I should like to stress another

point. I think it is a mistake for us to start a junior and say to him: "You are on the distribution side; you are going to be trained in gas supply; we are going to carry you right through on gas supply; and it does not matter if you do not know enough about gas manufacture." I do not say that we do that. The Gas Education Committee certainly does not say that. But there is a tendency for us to specialize far too early, and it is essential, in my opinion, that a good distribution man, even a good gas salesman, must have a knowledge of gas manufacture.

A Model Gas-Works for Training.

I was very much impressed with the system of the Boston Gas Company in America. They had a model gas-works set up in the schoolroom for gas fitters, and they commenced teaching their fitters the principles of gas manufacture. I thought it was extraordinarily sound. When they have taught the fitters the elementary principles of gas manufacture they go on to the question of utilization. We have a good deal to learn from America so far as systematic education is concerned, and the gas undertakings there—I am speaking generally now—are paying much closer attention to the education of their young workmen than we are in this country. I think it is one of those points that we have learned while in America and in regard to which many of us will desire to emulate them to some extent. Particularly does it apply to the training of gas fitters. I venture to say that today 90%, almost 99%, of the gas fitters who are visiting our consumers' houses, and who are the main arteries connecting the blood stream of our undertakings with the users of gas, do not know anything about the material they are handling other than that it is gas, and that they have to connect up the pipes to the undertaking; they know perhaps how to use the apparatus. A little knowledge of the constituents of gas and how gas is made would be enormously helpful to them.

A Live Committee.

Mr. John Terrace (Past-President): In spite of the flattering remarks that Sir Francis made about the little service I have been able to render to the Institution Education Scheme, I certainly feel much happier in a Committee room than I do when facing such an audience as this. I should like to pass on the proper share of the credit to those who have done more work than I have done in connection with the revision. I have always looked upon the Education Committee as one of the most live Committees that it has ever been my privilege to be connected with, and you need not be afraid at all about the Committee not doing anything that you would like done, because it is always on the look-out to meet every change of phase, and every change of view, and to do all it possibly can to make this scheme of education, which has now been working for ten years, the success which it deserves to be. I was glad that Sir Francis did not paint the picture too brightly. I think he summed it up very well when he referred to the very steady progress and that it was very encouraging; I think that described the thing exactly as it is. But I want to say that, although we have progressed so very well during the last ten years, I hope none of us is going to rest on his oars. When doing so much Committee work one sees the inside of the difficulties, which are not always clear to those outside, and it is upon that point that I wish to centre my remarks this morning.

On previous occasions I have used all the powers of persuasion that I possess to try to get all those in control of the Gas Industry to do what they can, to do their duty towards the younger members in order that the latter may obtain a good education to fit them for their future work. That point has been expressed by Col. Carr, who told you what he thought some of your responsibilities were. The point I want to make is that, while the Committee can arrange certain centres for education, and has been fortunate in having been able to arrange so many, it is not always easy for those centres to get sufficient students. There are two reasons for that. One is that there is needed a very great number of students in gas engineering to keep any technical college fully employed on this subject over a period of years, so that each centre is dependent on the places round about it. We have seen some cases where the classes at the centre have not been very well attended, while at the same time we have had complaints from the smaller towns round about that there were no opportunities for young men to attend the classes which would enable them to pass the examinations.

I rather want to couch my appeal to the chief executive officers of the undertakings in a different way this morning, and I want to suggest that each of those who are responsible for a staff and a body of workmen should, at least once a year, call for a list of all the members of their staff and all their workmen who are attending classes, and ascertain what certificates they have taken. I think that too often, in the rush of ordinary business, the chief has to delegate the question of education to his assistants, and he hopes that it is well done. Our experience shows that in many cases it is done very well, but I think that if the chief himself had a little more knowledge of exactly how matters stood—and that applies to small undertakings as well as to the large—he could pass it on to the local Education Committees, and thus enable them to carry on their work with much greater benefit than they are able to at present. After all, we must not forget that the boy is the father of the man, that we must look after the education of the rising generation, and that we not only owe it to them to provide a system of education such as we have endeavoured to provide, but we must do what we can to make them take advantage of it.

Some Reflections.

Dr. J. N. Long (Principal, Westminster Technical Institute): It was very kind of Mr. Alexander to invite me to join in the discussion, because, as everyone knows, my acquaintance with the Gas Industry has extended just over twelve months. Therefore, I come to such a discussion as this without any preconceived ideas. As the Principal of the Institute which has provided 50% of the whole of the trainees in the country—that refers specially to gas supply and not to gas engineering—I should like to offer, not criticism, but a few reflections on the scheme as I see it.

In the Report of the Board of Examiners for 1933 there is a general comment that: "Clarity of expression and sketching are two matters which should be given more attention by candidates. In many cases candidates did not apply the knowledge gained in the study of ancillary subjects when answering questions in the main subjects of gas engineering and gas supply." A little later it is stated that "... a lack of knowledge of chemistry and physics limits a candidate's ability to deal with the modern problems of gas distribution and utilization." In the paragraph dealing with the Higher Grade Certificate in Gas Supply it is stated that "Sketches were not of the type that might be expected from Higher Grade candidates, and little use was made of graph paper. Candidates were unable to make full use of their knowledge of chemistry and physics in its application to the problems of gas supply." There are other comments of a like nature in reference to Minor Course Certificates.

In saying that a student must in each year of the Course qualify in three subjects, a main subject and two ancillaries, you inculcate at once an inferiority complex in respect of the ancillary subjects; because I would point out with very great diffidence and respect, that the whole of this criticism I have referred to in the Report is a criticism of ancillaries and not of main subjects. If you assert that the student has to pass in the main subject and in two ancillaries, his mental picture is altered. In those circumstances, if you represent the body of knowledge required within a circle, the greater part of that circle represents the main subject and two small portions remain to represent ancillaries. On the other hand, if each of the three subjects is put forward as being equally important, the circle is divided into three equal portions. As I see it, if all the subjects were of equal importance, the Industry would get a trained candidate at the end of three years. As it is you are getting a candidate very well qualified in gas subjects, but absolutely poor in ancillaries. I find it necessary to emphasize again and again, as Sir Francis has emphasized, that we give an ordinary grade certificate in gas supply, not for passing in gas subjects but for satisfactorily attending a course, and as I see it the Industry wants well-equipped, generously trained employees, but it will not get them by emphasizing the main subject. It will get them if it is stated that the students must pass in three subjects, all of which are of equal importance. It is rather notable that one never finds a student who has done brilliantly in the ancillaries and who has not done well in the main subject. One frequently finds, on the other hand, students who have done well in the main subjects and poorly in the ancillaries. Again, if students happen to be courting—and many of them are—you will find that their courting evenings are generally arranged on the evenings devoted to ancillary subjects at the Institute. [Laughter.] You will find, too, that if he is working overtime he does so on the ancillary subject evenings and not on the main subject evenings.

Importance of General Knowledge.

I do seriously urge the importance of general knowledge, for no longer is the Gas Industry to be satisfied with people who are competent merely in gas fitting or gas supply. For example, if the Grid scheme for gas comes into being—and I think it is likely to—you will want surveyors, students who can work out with a certain amount of ease the cubic contents of trapezoidal trenches and

many other things. But you have not got them, because of the insistence on the main subject the whole time. I would go so far as to suggest that the ordinary grade certificate could be obtained by an averagely intelligent enthusiastic student after attending one night only, because the standard demanded by the questions for the main subject are such that the man requires precious little knowledge of ancillary to get through. My suggestion, if I may very diffidently make one, is that the Institution ought to set about removing the inferiority complex which now exists in respect of ancillaries, and that it ought to assess definitely the three subjects in the final year. In other words, instead of assessing the main subject only in the final year, it ought to find out what is being done up and down the country and make the three subjects of equal importance. We at Westminster possess a Board of Examiners and we are extremely keen on this; a number of students who have done well in the main subject have come down this year owing to not having acquired the necessary ability in ancillaries. A few words have reached my ears about ancillaries, for students say that ancillaries are awkward at Westminster and that they are going to West Hampstead. I do not want that to happen. I find that the word "ancillary" means "subservient to" or "subordinate," and I think that is entirely wrong.

Mr. C. H. CREASEY, of the Board of Education, also made a contribution to the discussion.

A LITTLE INCOMPLETE.

Mr. F. C. BRIGGS: We can assume that the Education Committee will not rest on its laurels. Although a Member of the Executive Committee of the scheme, I do not think we need have any hesitation in congratulating ourselves that this is the most heartening Report the Gas Education Committee has had the pleasure to present. I think it is a little incomplete in one sense, that although giving the history of the scheme, it omits to mention some of the teething troubles that the scheme has experienced. In 1927 some revision seemed to be necessary, and in 1929 the scheme was again revised, mainly to deal with the external students, but also to co-ordinate the experience of the past. At that time fears were expressed that this might lead to an enormous increase in the number of external students, but experience has shown that not to be the case. In Appendix I. of the Report it is shown that the increase in the total number of students from 1924 to 1929 is from 30 to 50 per annum, and then the total number drops when the new scheme comes into operation. I think students were unable to understand what was intended. In 1930 the number was 22 less than in 1929, but after 1930 the number increased again. But the increase in the number of external students is very much less than the increase in the number of internal students. In 1933 the external students numbered 105, as compared with 125 in 1928 and 1929—*i.e.*, before the revision occurred. That confirms what we find on the Committee—the students to-day, so far as we can see, are keener than they have ever been, and they are of a distinctly better type. We have Degree men applying for small exemptions for ancillary subjects; recently one of the men asking for a certain exemption had passed his London Matriculation with Honours, he had an Inter. B.Sc., and a First Grade Gas Supply Certificate. He was a fitter.

That leads me to ask where all this is leading us. This may sound heresy, but I think it needs to be emphasized, in the interests of students, that to come into this education scheme and to obtain the final certificate is not the only requirement for a post in the Industry. I do think that those Executives who advise students need to be careful to advise the right type of men to take the right type of course. I think there is a fear, which we have to bear in mind, of over-education. By that I mean that unsuitable students with a flair for education and examinations may take courses which lead them nowhere, and I think that is liable to cause dissatisfaction among some of the younger men. I do not want to mention that as a discouragement in connection with the scheme, but I think it is necessary to face that fact and to see that the right type of men come along, and that students realize that this education scheme is not the only requirement. There is needed a good preliminary education, and also character, for the work that has to be done.

Then one is led to ask, What is the result for the Industry? Are we facing the fact that for the same positions and emoluments we need greater education and greater capacity than formerly? To some extent that is true. On the other hand, if we are to get the right type of student, as we are now getting, and to encourage him to come along, the Industry needs to look for openings for him; it must tackle the problem of promotion, and, if necessary, adequate compensation by way of emoluments when we have the right type of man. I think it is a slight reflection on the Gas Industry that so many of our very best men, having been trained, are scooped up by the contractors.

Corrosion from Products of Combustion

[33rd Report of the Joint Research Committee]

Research Chemist: JAMES W. WOOD, M.Sc.Tech., A.I.C. *Research Assistant:* E. PARRISH, M.Sc.Tech.

The Report was introduced by Mr. Thomas Hardie (Chairman), Prof. J. W. Cobb, C.B.E. (Hon. Secretary), and Mr. James W. Wood (Research Chemist).

The PRESIDENT: I have to apologize for the inability of Prof. Smithells to attend this meeting to-day. His absence is due to illness, and we regret it very much, because he always tells us something of interest, and he has a charm of manner which appeals to everyone.

Mr. C. A. MASTERMAN: There can be little doubt that the present report is going to lead to most important and far-reaching results. In the general introduction reference is made not only to the investigation into the effect of sulphur derivatives in the products of combustion, but also the very topical problem of gum formation in gas. In the long run there may be a distinct link between these two problems in that, while the preliminary investigations into sulphur products indicate the desirability of a greater refinement of the gas, the incidence of the gum problem is almost certainly due to the extension of refining processes in gas manufacture.

HIGH QUALITY OF BRITISH GAS.

This is, perhaps, an appropriate moment for one like myself on the utilization side of the Gas Industry to extend my congratulations to the engineering side in regard to the consistently high quality of gas as now produced. The demand for ever-increasing accuracy of control has led to the development of increasingly precise automatic devices which necessarily demand a very fine degree of standardization in gas quality itself. During my recent visit to the United States with the Institution's party, I was greatly impressed with the comments from the utilization engineers on that side who remarked more than once that it was only the consistent and high quality of the gas as manufactured in Great Britain that made possible certain devices and developments in technique which we look upon as quite straightforward but which, in America, I am told cannot satisfactorily be used.

At an early stage in the Leeds investigations I had the privilege of discussing with Prof. Cobb and Mr. Wood the proposed programme of work, and I must congratulate them on the progress they have already made. The present report is, of course, only in the nature of a preliminary survey, but already draws attention to the benefits which would follow a reduction in the sulphur content of town gas. It is much too early yet to state what the economic limit for sulphur may ultimately be found to be. There is clearly the need for very close co-operation between the utilization and the manufacturing side in the determination of this very complex economic problem. On the one hand there is the varying cost of stripping sulphur out of gas to various lower limits; on the other hand there is a direct measurable benefit of low sulphur gas in the direction of diminishing the need for maintenance of appliances. We have at Watson House carried out tests on a number of pairs of characteristic appliances using gas under the same conditions and over the same period. One appliance of each pair has been operated on a high sulphur content gas, the other on a low sulphur content gas. The conditions have been so adjusted artificially as to cause the maximum of corrosion, &c., but the contrast between the high and low sulphur content gases has been in several cases quite

astonishing. One very marked feature which has been noted has been the greatly increased amount of condensation which has taken place in the appliances burning the high sulphur content gas, due directly to the raising of the dew-point in the presence of sulphur oxides. Any consistent lowering throughout the country of the sulphur content in town gas will have a marked effect on certain features of appliance design and will make easier the task of the designer.

An allied problem lies in the decreased condensation and corrosion in the flues attached to central heating boilers operating on low sulphur content gas. The central heating load has not yet by any means been fully explored and its ultimate development to an important sales outlet may very well turn on this difficulty which at present is experienced in long flues attached to such boilers—a problem which has been a source of considerable embarrassment in the United States and Canada where the use of central heating is almost universal.

Sulphur Content and Comfort.

It is scarcely necessary to add that any reduction in the sulphur content of gas would be reflected in connection with the comfort conditions obtained where flueless appliances of any sort may be used. In this connection, too, we are carrying out tests at Watson House to determine under practical conditions what proportion of the sulphur derivatives of the gas can be recovered from the air of the room and what proportion is absorbed by the plaster walls or by any condensation which may occur.

In emphasizing the importance of the sulphur content to the utilization side of the Gas Industry I am in no way attempting to pre-judge the issue. There is here a balance of economic and other factors, and my chief hope is that the present investigation may proceed sufficiently far for a correct determination to be made so that in time we may know whether the apparent advantages of further refining of the gas can be economically justified.

Value of Central Research.

In conclusion I would like to point to this problem as a topical example of the value of research under some central body such as the Institution of Gas Engineers. While we at Watson House are carrying out certain *ad hoc* tests in this connection with a view to determining our immediate policy, such tests are necessarily incomplete when viewed from the point of view of the Gas Industry as a whole. When this problem is undertaken by research workers for the Institution they are in a position to take a wider review of the literature which already exists; they can establish contacts with undertakings throughout the country to determine what is the varying practice regarding appliances used, the maintenance policy, &c.; they can obtain information from the manufacturing side throughout the country regarding the various manufacturing processes and the application of further sulphur purification to those processes. Such work lies outside the scope of any one undertaking, who must necessarily consider first their own more local interests. If, however, they can assist the investigations now going forward at Leeds I feel sure the laboratories of the various undertakings throughout the country would be happy to co-operate in discussing their own results and experiences with the Leeds research workers. For myself, I always have great pleasure in discussing with Prof. Cobb or Mr. Wood such results as we obtain, and I usually find they are in a position to suggest new points of view which are of great value to ourselves.

A New Slogan for the Industry.

Dr. H. Hartley: In the penultimate paragraph of the summary of the report, it is stated to be desirable "to obtain information as to the relation between the sulphur content of the gas burned, the amount of condensation, and the extent of corrosion which occurs with different materials." It is then mentioned that the Committee have prepared two types of apparatus to study the comparative action of the products of combustion from different materials "with a view to selecting the most serviceable materials for the construction of gas appliances."

The Committee will undoubtedly collect and place before the Industry interesting and useful information. That is assured by the fact that the experimental work is in the hands of Mr. Wood, all of whose reports have been characterized by thoroughness. At the same time I cannot help feeling that in authorizing the investigation to be undertaken, the General Research Committee are really burying their heads in the sand. I think everybody knows that much of the trouble due to corrosion of metals in gas consuming appliances is a consequence of the sulphur content of the gas. I have heard no suggestion that one of the Research Committees of the Institution should report on the problem of removing sulphur from domestic coal gas. While realizing that the traces of oxides of nitrogen produced during combustion must be playing some part, perhaps not an insignificant one, in the destruction of apparatus, those of us who have had to concern ourselves with the design of appliances have for long felt one of the greatest boons which could be conferred upon our Industry would be effected by the devising of a process which would enable sulphur to be eliminated *in toto*.

When public discussion takes place about the use of coal gas, and especially its use in flueless apparatus, many advocates are prone to talk glibly about the products of combustion consisting largely of CO_2 and nitrogen, and to tell the world at large how harmless is CO_2; yet all the time it is realized that the 20-30 grains of sulphur present in each 100 c.ft. of coal gas cause a greater nuisance than all the CO_2 and steam, and that if only we could obtain a domestic supply of gas free from sulphur, the scope for the application of the fuel would be largely increased.

Now this Committee will ultimately lay before us facts which will drive home the pernicious effects of the sulphur gases. I hope that when their reports are presented, those who happen at that time to be controlling the destinies of the Industry will take them to heart and will inaugurate work with a view to eliminating sulphur. Much has been done by the two largest London Companies, but very much has still to be done throughout the country, and the Industry ought not to be satisfied with the standard attained in London.

There is little in the report itself which calls for comment. That serious corrosion of metal fittings by coal gas products might result, even if there were no appreciable condensation, is suggested by the deterioration which takes place in the brackets of lighting fittings.

With non-condensing water heaters there is a minute amount of condensation, when the apparatus is started up from cold. The condensation, however, is not sufficient to allow of the accumulation of noticeable drops of liquid. In the report it is suggested that the production of a non-condensing circulator involves a loss in thermal efficiency. So far as my own Company's products are concerned, this has not been the case. In fact, our non-condensing apparatus has a higher thermal efficiency than the condensing type which preceded it, and is not lower in efficiency than similar types of condensing apparatus which we make. In appliances such as water heaters, in which condensation does take place, the amount of steam that is liquified is only a small proportion of the 1 c.ft. which is formed for each c.ft. of coal gas burned. When using a water heater of the condensing type under flow test conditions, with cold water entering at such a rate that its temperature was only raised by 40° F. during passage through the appliance, only about 1/7th of the water produced on combustion was condensed. The latent heat of condensation of steam represents roughly 10% of the calorific value of the gas. It will thus be seen that only about 1½ units in the efficiency figure results from the condensation of the steam.

I anticipate it will be found that corrosion can take place without condensation. The amounts of material which have been collected during the Committee's tests indicate such a result.

Sulphur removal is effected to quite a considerable extent in several types of apparatus in which condensation occurs, but the extent of the removal of sulphur is largely influenced by the actual corrosion of the apparatus. Cast-iron appliances are particularly effective, and some 50-60% of the sulphur in the products may be removed, provided corrosion of the appliance is taking place. When the interiors of such apparatus are enamelled it is found that the sulphur removal is much decreased—a result which is indirectly confirmed by the present report.

Sometimes people comment on the peculiar odour associated with the use of certain types of flueless apparatus. This peculiar odour is, I think, a result of the action of the sulphur acids in the condensate on cast iron, and is probably due to the evolution of hydrocarbons in small quantity.

Assuming the Committee ultimately are in a position to advise that corrosion of apparatus can be avoided, or be much reduced, by the employment of certain materials, I think we may take it for granted that the adoption of such special materials will, unfortunately, involve a considerable increase in cost of production. I feel it will pay the Industry to continue with the commoner materials, and remove the sulphur from the gas, rather than employ special substances capable of resisting the attack of the very corrosive products of combustion of present-day town gas.

"Sulphur Must Go" would make a good slogan for the General Research Committee of the Industry.

Mr. F. Firth (Leeds): This is one of the most important problems facing the Industry. Not only is the cost of replacements through corrosion a heavy drain on our finan-

cial resources, but the bad effect of appliances being put out of order and becoming unsightly due to corrosion troubles, means a type of publicity which is undesirable and which may ultimately be a greater loss than that sustained in replacing appliances.

An investigation of this description should be carried out concurrently with facilities for the examination of appliances actually in use on the district, and in this respect Mr. Shapley has always afforded Mr. Wood every facility for doing this where possible. At this point I would like to pay tribute to the ready way in which Mr. Wood places his services at our disposal when any problem is brought to his notice.

The important question of the best means of dealing with corrosion will tax the best brains and can only be done by systematic investigation on the lines proposed, and while it is not to be expected that the Research Staff will, in the near future, be able to present a cut-and-dried method for overcoming either corrosion or its effects, it is to be hoped that the information collected will provide a basis in which some progress can be made in at least reducing corrosion and allied troubles.

Condensation in Flues.

A problem met with and requiring immediate attention is the character and effects of condensation in flues away from the appliance. The effect in chimney flues, false roofs, and enclosed areas should be investigated; and with the establishment of facts in place of fancies, some solution to this problem might be found. In a case of which I have experience, the flue products from a geyser are discharged into a false roof. On inspection it is found that on the floor in the immediate vicinity of the flue discharge there is an accumulation of lime, &c., which has dropped from the roofing tiles. The difference in the quantity of débris at this spot compared with other parts of the underdrawing would indicate that the flue discharge is responsible. Can the authors enlighten us on the subject?

In an examination of the analyses given in the paper it is significant that the amount of sulphur acids found in the condensates where metal is absent are comparatively small compared with those where metals are present. Does this indicate that the oxides of nitrogen are relatively inert in the absence of a metal, and the supposed similarity in the catalytic action of the oxides of nitrogen, in sulphuric acid manufacture and flue gases, does not operate at the low concentration of sulphur and nitrogen oxides found in flue gases, and that it is necessary to have an accelerator (metal) present in flue gases to complete the reaction? If concentration is an important factor, then it follows that a reduction in the sulphur content in the gas is a desirable object to aim for.

Another point which would be worthy of being cleared up is whether the combustion products from a flueless heater, when clear of the appliance, and after the enormous dilution of both the sulphur and nitrogen oxides with air, are likely to form sulphur acids on fabrics, &c., which might be in the vicinity—incidentally the contact with metal is absent, except probably as oxide where the fabric has been mordanted.

We shall be very interested in the progress made in these investigations, which will demand all the knowledge and ingenuity the research staff can put into the job.

Merits of Hot-Galvanized Cast Iron.

Dr. H. T. Angus (London): I have been particularly interested in this investigation because I came into contact with this trouble in gas appliances some years ago and went to the trouble of looking through the existing literature to see how much had been done with regard to it. To my surprise, I found that very little indeed had been done. Apart from the papers already referred to in the report, I can only find one other treatment of the subject, and that was by W. E. Dennison, who published it in the *Foundry Trades Journal* dated Sept. 12, 1929. He used methods which I do not think are so satisfactory as those devised by Mr. Wood, but they gave certain useful information. He collected the products of combustion, passed them through a Liebig condenser, collected the condensate, selected certain metals, and applied the condensates to the metals in a standing solution which was periodically renewed. The metals he used—he gave a considerable list—included one or two of particular interest, and some points about his work I think may interest Mr. Wood.

The first point is that the condensate which was obtained consisted mainly of sulphurous acid, with very little, though a definite trace, of sulphuric acid. Oxides of nitrogen were not estimated. The tests indicated the rather curious result that cast-iron plated by a hot galvanizing process with zinc seemed to be preferable even to copper in its resistance. It is possible that some explanation of this effect is to be found in the action of the nitrates, which does to some extent inhibit the corrosion of zinc when present as salts. Some work by Newton Friend, I think, indicates that. The effect is most noticeable with regard to the skin. The cleaning of the surface of the cast iron, wrought iron, and mild steel did not reduce, but it improved, the corrosion resistance. That is rather contrary to certain experiences which we have been disposed to accept before. But to some extent I think it is borne out by work done by the Birmingham Gas Department in connection with copper back-boilers, where they found that a surface skin of oxide definitely did not reduce the deterioration of the copper by high sulphurous cokes. A certain amount of work was also done on copper and copper-nickel alloys, and it is rather interesting to note that the addition of nickel does not appear to reduce corrosion to any appreciable extent under these conditions. I can to some extent confirm that, because in 1929 we were considering doing work on very similar lines, and, although we had to give it up on account of other duties, we made up a certain type of 2½-gallon geyser in 80/20 copper-nickel, and we found that the corrosion was almost identical with that of a plain copper machine. I do not say that it is distinctly more than in the new stages of a tinned copper machine. Actually we burned about 4000 c.ft. in it, and the condensate contained 0·14 gramme of free sulphuric acid per 100 c.c., but there was no trace at all in our test of sulphurous acid. Admittedly the analyses were delayed by a day or so, but the condensate was kept in stoppered bottles, so that the oxidation was not likely to have been so great as to remove any large quantities of sulphurous acid if such acid had been present. I think it becomes evident that the ratio of sulphurous to sulphuric acid attained in the condensate is also a function of the reactivity of the metal upon which it is condensed.

The corrosion of cast iron is probably more serious even than that of copper. I can confirm definitely the statements of Mr. Wood that sulphates, strangely enough, are absent from the corrosion products of iron where it is not definitely in continued contact with a condensate. Sulphates seemed to drain away or to be otherwise removed, and I think that in connection with the corrosion of iron the presence of CO_2 in the condensate is going to be a very important factor, and the sulphur probably serves more as an opening agent before the CO_2. The action of the condensate upon copper is rather obscure; it is not a direct change into the sulphate, and there may be certain intermediate stages of sulphide and possibly cuprous sulphate. I am not clear what happened, and I think it depends to some extent on the temperature at which the condensate is formed and which it subsequently attains. I think definitely that the type of apparatus devised by Mr. Wood will give much more valuable results than that used by Mr. Dennison, in that the former is a continuously running appliance and the products of condensation are actually running through and running over the metal to be tested. Standing tests are notoriously inaccurate and give very misleading results.

I have particular interest in the method which Mr. Wood uses for analysis, and I think one of the most valuable parts of the paper produced by him is his detailed description of his methods of analysis and test. That is particularly valuable to people who follow after him in investigating similar problems.

Laboratory Tests on Corrosion.

Mr. Gilbert B. Howarth (Newcastle-upon-Tyne): I have been much impressed by the speculations put forward to explain the mechanism of the process by which oxides of sulphur are retained. This part of the report deserves careful study, as it may throw light on unexpected results sometimes obtained in actual appliances.

The tables showing the results of analysis of corrosion deposits give some idea of the complexity of the chemical work involved, and Mr. Wood has done well to account for so nearly 100% of the material taken. It is interesting to learn that the moisture determination is not such a simple test as is commonly supposed.

Two types of tube apparatus are described. The type in which the outside of the tube is subjected to corrosion has many advantages, and it would be a pity to sacrifice them for the sake of a relatively small saving in cost. The bending of sheet metal after plating is likely to introduce structural modification of the surface, and it would be preferable to adhere to the commercial practice of plating the finished article.

In addition to the metals already included in the programme of testing, a number of other materials may be suggested; for example, soldering and brazing materials, lacquers used for protecting metals, and numerous substances used for domestic decoration and furniture, such as

paints, plasters and wallpapers, wood, synthetic plastic products, book-binding materials, and upholstery.

It is usually assumed that sulphur compounds are the only source of corrosion. As, however, carbon dioxide, water vapour, and oxides of nitrogen are also present, it may be found that the improvement to be obtained by the partial removal of sulphur compounds is not as great as would be expected. To settle this point I suggest that some of the tests should be repeated at an early date with a special gas entirely free from sulphur.

While it is usually understood that sulphur in products of combustion is in the form of the oxides, there is the possibility that a proportion of it may be present in other combinations. This is particularly likely when combustion is seriously incomplete, and a further exploration of this point might be useful.

New Apparatus for Estimating SO_2.

Mr. C. J. D. Gair (London): My suggestions to-day are mainly from the analytical point of view. Mr. Howarth has dealt with the question of corrosion of pictures and other objects, and it is from this standpoint that the sulphur dioxide in the air itself is of very great import in this investigation. It is not a question merely of condensates, though they are important, of course. In this connection I can quite understand the difficulty of estimating sulphur dioxide continuously or from time to time owing to the minute quantities involved. Fortunately, however, quite recently a new apparatus has been brought out by Messrs. Adam Hilger, of London, which might be of use in this connection; it is a new form of nephelometer. Nephelometry is too big a subject to deal with at the moment, but it consists in the observation of the scattering of light by minute particles and estimation by means of a buffer suspension alongside. Thus it should be possible to pass the products of combustion—namely, the ordinary air of the room—through a suitable solution containing barium chloride and probably a little hydrogen peroxide, and estimate continuously the amount of sulphur dioxide from the gas burning. This information might be of considerable value, and I put this to the Committee as a suggested method of watching the accumulation of sulphur dioxide in the air of a room. The nitric oxide content might possibly be looked at from the point of view of the Rayleigh interferometer; it is a new way of approach, and these methods might well be brought into line with the general work of the Committee and would be very interesting indeed as check tests.

As to intensive tests, one must add a word of warning, because, generally speaking, they give misleading results unless they are watched with very great care.

The question of protective coats is one which should be considered also, and probably, too, the passivation of metals by nitric acid. The Committee is to be congratulated on the excellent start it has made.

Ammonia Content of Gas.

Mr. R. B. Clayton: Most of my time is taken up with the purification of gas, and I find at the present time that the question of the ammonia content of the gas is treated by the engineer in a manner quite different from that of five years ago. I find that in many cases as much as from 20 to 25 grains of ammonia are going into the boxes, and in that case there is no doubt at all that considerable amounts of ammonia must go forward in the gas stream. Therefore, I should like to ask the authors if they have determined whether nitric acid is present due to the ammonia being in the gas. We know that in sulphuric acid manufacture the nitric acid is produced by passing ammonia over a catalyst, there being 85 to 95% conversion of nitric acid, and it appears that this plays some important part in certain gas streams at the present time.

I should also like to ask whether the Committee has found that hydrocyanic acid plays any part in the formation of this nitric acid. Has Mr. Wood analyzed the gases passing through the combustion chamber for ammonia and hydrocyanic acid? We know that hydrocyanic acid can be split to form nitric acid.

With regard to the presence of sulphur I agree with Mr. Hartley. It seems to me that to tackle the elimination of sulphur compounds is really the best way of solving this problem. I feel, from the observations I have heard to-day, that the profession is now willing to consider some process which would eliminate the sulphur, and I am at present working on it. I think that is the solution of the problem, because it has been stated that it is not a question of corrosion of the apparatus but of the sulphur in the air. Anyone who goes into a small room where the ordinary gas is burning can definitely smell the sulphurous acid, and it should be the object of the Institution to eliminate that as well as corrosion.

Gum Formation.

Mr. W. W. Townsend (Colchester): I was very much interested in Prof. Cobb's reference to the subject of gum formation, and it was rather intriguing to hear Mr. Masterman's reference to it. He said, I gather, that the problem of gum formation arose from the extra refinements of the production of gas to-day. Is that so, or is it not so? Mr. Masterman stopped just when his remarks were getting most interesting on that subject. My object in speaking now is to urge that investigation of the subject of gum formation is worthy of the special attention of the General Research Committee. We have heard a good deal about one bogey of the distribution staff—*i.e.*, the products of combustion and the sulphur compounds—a very old subject, but I venture to say that this subject of gum formation is nearly as important. We are going in more and more for thermostatically controlled gas apparatus; we have got rid of one bogey, in the form of naphthalene. Modern practice is to remove the water vapour and get rid of this trouble. Now we have this extraordinarily difficult problem of gum formation, and I suggest that it is not sufficient to burden the Committee—it already has its hands fully occupied in one investigation—with this subject of gum formation, which is very complex and might very well be given special consideration.

Importance of the Inquiry.

Mr. W. J. A. Butterfield (London): I think the Research Committee is to be congratulated upon having taken up this matter. It was brought to my mind forcibly yesterday evening when a gentleman asked if I could give him some information about the sulphur contents of the gas in two different areas in the London district, both of which are supplied by the same Company. The facts he gave me were that his firm, who are large producers of some food products, used very large quantities of gas in ovens. They have recently moved their factory from one area to another, and there has been a very marked increase in the corrosion of their appliances in the new area. From the general knowledge I have of that gas company's works arrangements, I could only assure the inquirer that it was unlikely that there was any increase in the amount of sulphur in the gas in the new district as compared with the other one; indeed, it was probably rather lower. But the fact that an increase of the corrosion in such circumstances has been noticed—and it is a very marked increase—indicates the importance of this inquiry.

The other point to which I would like to refer is with regard to the Boys calorimeter where the condensation occurs. In that connection reference is made in the report to the fact that protective coatings are of very little avail. It is mentioned in the book by Hyde and Mills on gas calorimetry that the containing vessel of the Boys calorimeter has been made, for trial purposes, of lead sprayed copper, and that after two years' intermittent but frequent use that coating has stood up very well. I can only add that it is still, a year later, standing up very well. Further, for the same vessel Staybrite steel has been tried, and that has stood up perfectly well for something over two years. So that for particular uses it is worth considering other materials.

Then reference is made to the products from the Fairweather recording calorimeter, where there is the continuous condensation. The ordinary Boys calorimeter does not go to pieces more quickly when it is in continuous use than when it is in intermittent use; and two points of difference between the Fairweather calorimeter and the ordinary Boys calorimeter continuously run are, that in the former the air is saturated and the type of burner used is different. I think it might be worth while pursuing the question of whether the same gas burned in the same appliance gives more or less corrosion according to the type of burner. The ordinary Boys calorimeter has luminous flames, and it may be that the nitrogen oxides which are produced in greater quantity from the luminous flames, accelerate corrosion in that instrument.

The President: Perhaps Mr. Wood has something to say with regard to the discussion, and I suppose he will reply fully through the Technical Press.

Mr. Wood: I am very pleased indeed to have had the opportunity of listening to such an excellent discussion. It confirms the opinion of the Research Committee that the problem is an important one and that the Industry as a whole is keenly interested in the work. It will give the Research Staff considerable encouragement to pursue the work and to devote our energies to carrying the investigations forward.

Liquor Effluents and Ammonia

[3rd Report of the Sub-Committee]

Research Chemist: A. Key, Ph.D., B.Sc. *Research Assistant:* W. Etheridge, B.Sc. *Temporary Research Assistant:* A. H. Eastwood, Ph.D.

Mr. Charles F. Botley: It is only necessary for me just to introduce this report and to express the hope that we may have a fruitful discussion this afternoon. At the same time I should like to take the opportunity of acknowledging through the Institution our thanks to the Industry and those who have given us such valuable help in the work which my Committee has undertaken. I will also once more make an appeal that anyone who has any trouble on this subject should be good enough to let Prof. Cobb or myself or our Research Chemist know about it. There is only one other point, and that is my thanks to the members of the Committee and the Research Committee for the assistance they have given this year.

Prof. J. W. Cobb, who also made a few introductory remarks, said: In the first place I should like to take the opportunity of pointing to one aspect of the Committee's work to which Mr. Botley in his modesty has not found it possible to refer. A great deal of quite useful advice is given to members of the Institution on personal application to Mr. Botley and Dr. Key on questions which are relevant to the work of this Committee but which are not of sufficient general interest to be embodied in any official report, and I want to point out that the absence of that work from the official report does not in any way detract from its usefulness, as I am quite certain a number of you have had occasion to determine by experience.

In order to bring the matter up-to-date I visited Rothamsted yesterday and saw Sir John Russell and Dr. Crowther, who has been personally closely identified with the experiments; and I will read a statement from them which will define what the position is so far as it has been ascertained up-to-date:

Field Experiments on Ammonium Bicarbonate.

The experiments made in the first instance were intended to make a comparison of sulphate and bicarbonate when applied by the methods and under the conditions usual for ammonium sulphate. The results are not complete. Of the 10 so far obtained, 7 showed no difference between bicarbonate and sulphate and 3—one on grassland and two on potatoes—showed appreciable inferiority of bicarbonate to sulphate. It is evident that further study on the mode of application of bicarbonate is necessary in order to make a final and just comparison possible.

Dr. A. Key then formally introduced the report so far as its technical contents were concerned.

The Dephenolating Plant at Partington.

Mr. A. L. Holton: You will note from the Appendix that I had the honour of contributing to the Committee the results of a further year's work on the dephenolating plant at Partington, and for the first time it is now definitely a paying proposition in addition to the fact that there is a purification, from the oxygen absorption point of view, of 85%. I note in the report that Dr. Key has pointed out that the phenols that we in Manchester have been so anxious to take out are really of very little account, so that it is just as well that they are now a paying proposition. I want to suggest, however, that you would have at any rate less objection to the discharge of the liquor into the sewers where you have taken the phenols out than you would have if they were in because there is something surely in the point that the oxygen absorption figure would be so very much less. In our working of the plant at Manchester one very interesting point has been brought out in the report I have made. In previous years I have pointed out that the benzole loss was rather high. The main loss, on investigation, has been found to be at the vent pipes in the plant, which, added together, has made such a serious loss. By bringing all the vent pipes of the plant together and passing them up a tower in which one washes them with ordinary gas oil, it has reduced the losses of benzole to such a figure that they are nearly negligible. I want to lay stress on that for this reason: So many of us now have benzole plants, and I suggest to you that this throws light on the care with which you should deal with the vents on your benzole plants.

May I refer again to this fractional appraisement of the liquors? I hope we are not going to have a costing-out by sewage departments generally into saying that you have so much thiocyanides, and that therefore you are going to be charged so much. I think the whole of the work done by Dr. Key is to point out those bodies that are causing much trouble, and we ought to attack them and see they are eliminated. Dr. Key has pointed out that you want to deal with the gas when it is practically oxygen free, but I suggest that that is nearly an unknown quantity with us at any point. I think the best that any of us would have would be 0·3 to 0·4% of oxygen, and I should like to ask you whether such a small amount would affect the oxidation bodies in the way of which he is speaking.

This brings me to the question of the admission of oxygen for the rectification processes in the purifiers, and I suggest to you that it is sound practice only to admit the oxygen prior to the purifiers themselves, and not, like so many of us do, admit the oxygen on the exhaust side of the exhausters.

I am particularly interested in the ammonium bicarbonate experiments that occupy so much of the report, and may I just ask in conclusion, would it be possible to use a plant such as we have at Partington for the ammonium bicarbonate process? It seems to me that it would. I am looking forward to the further experiments on these lines and to have an opportunity of putting down one of the largest scale plants at our Droylsden Works, which has a capacity of half a million, which, I suggest to the Committee, is always at their disposal.

The President: I think it will be your wish that we should thank the authors of this communication, the Chairman, Prof. Cobb, Dr. Key, and also Mr. Holton for his communication in the Appendix. I propose that the best thanks of this meeting be given to them.

The vote of thanks was carried with acclamation.

Dr. A. Parker (Assistant Director of Water Pollution Research of the Department of Scientific and Industrial Research): It is with much pleasure that I take this opportunity of contributing to the discussion on the valuable report which has just been presented. The report describes a large number of experiments, carefully planned and carried out, and reflects great credit on the energy and initiative of Dr. Key and his two assistants, Mr. Etheridge and Dr. Eastwood. As already explained by Dr. Key in introducing the report, the experiments during the past year have dealt with the disposal of liquor effluents in admixture with sewage, the distillation of phenols from ammoniacal liquor and a new process for the manufacture of ammonium bicarbonate—that is, with three distinct but closely related subjects.

With regard to the process which Dr. Key has proposed and tried on a small scale for the manufacture of ammonium bicarbonate from the ammonia and carbon dioxide in crude coal gas, experiments on a much larger scale are required before a reliable opinion can be given as to whether the process is likely to be commercially successful, and it is hoped that it will be possible to arrange for such large scale experiments. In any case, the fundamental information which Dr. Key has obtained with the object of specifying the physical and chemical conditions necessary for the operation of his process will be most useful in devising and developing other similar processes.

The experiments described in Section IV. on the removal of phenols from ammoniacal liquor by distillation have definitely shown that distillation would be a very costly method of removing phenol from ammoniacal liquors of the kind produced in this country, as phenol and cresol are much less volatile in steam than ammonia. In general, the results confirm those obtained a few years ago by Dr. Lewis Bailey in experiments made to examine a claim by Heffner and Tiddy in a patented process for separating phenols from ammoniacal liquor.

Suitable Condensation Plant.

With regard to the effluent problem, it is obvious that in the first place every effort should be made so to design the plant for the condensation of tar and liquor that the volume and polluting character of the resulting effluent are reduced to a minimum. Secondly, methods by which any of the

effluent can be destroyed at the gas-works, such as evaporation of devil liquor by spraying into a hot chimney, using effluent in place of water or steam in producers of retort settings or perhaps for quenching coke, should as far as possible be adopted. I say that reservedly because of the risk of atmospheric pollution. These two phases of the subject have been considered in some detail in previous reports issued by the Institution. Even after a good deal in these two directions has been done at the gas-works, there remains in most cases a considerable quantity of highly polluting effluent for disposal. So far as the majority of gas-works are concerned, the most satisfactory method of disposal of the remaining effluent is to allow it to flow under controlled conditions into the local sewers for treatment in admixture with sewage at the sewage disposal works.

In the past it has been assumed that the polluting character of the effluent, as measured by the permanganate test, gives an approximate measure of the additional burden thrown on the sewage purification system. For example, it has been assumed that if the oxygen absorbed by sewage from permanganate in the usual test is increased from 10 to 15 parts per 100,000 by the addition of about 0·5 volume of gas effluent to 100 volumes of sewage, the work of purification by oxidation is increased by 50%. The processes employed at sewage works, however, involve biochemical oxidation and not oxidation by permanganate, and it may be that the permanganate test gives an erroneous impression. Further, the difficulties of biochemical oxidation of the various constituents of gas-works liquors and effluents may not follow the same sequence as the amounts of permanganate consumed by the constituents in the usual test. Dr. Key's laboratory experiments during the past year have been planned, therefore, to measure the relative rates of biochemical oxidation of the constituents when mixed with sewage and treated in percolating filters or by the activated sludge process.

In general, the results indicate that in the concentrations in which they usually occur, and even in much larger concentrations, phenol and catechol, the latter representing higher tar acids, are readily oxidized and have no adverse effect on the biochemical oxidation of sewage; thiosulphate and thiocyanate can also be oxidized and have little or no adverse effect provided they are added gradually at first to allow a suitable bacterial population to develop. Sulphide appears to be definitely detrimental. These conclusions, derived from laboratory experiments with individual chemical substances, however, are not in agreement with the results of experience in the treatment of mixtures of sewage and gas-works effluents at sewage purification works. It is ordinarily found that the addition of gas-works effluent increases the difficulty of biochemical oxidation of sewage to an extent which varies with local conditions.

It thus appears probable that gas-works effluent contains some substance or substances not determined by the usual method of analysis employed. This difference is, I understand, now being investigated, and it is hoped that the further work will lead to some reliable method of assessing what additional burden is thrown on the sewage treatment works by the addition of gas-works effluent, and, of course, finding out the difference between synthetic and natural effluent.

There is no doubt that the Institution's work on this subject has been invaluable in bringing about a much better understanding between the managers of gas-works and of sewage works, and already several papers on the Institution's work have been presented by Dr. Key and his predecessor Dr. Monkhouse at meetings of Managers of Sewage Disposal Works on the invitation of the Institute of Sewage Purification. It has also led to many investigations by sewage works managers themselves, and I can assure you that the work is followed with keen interest by the Water Pollution Research Board of the Department of Scientific and Industrial Research.

Growing Technical Interest.

Mr. F. R. O'Shaughnessy: For many years now I have been interested in this question. The technical interest of the problem grows as each year brings more precise and definite information, and I must congratulate your Sub-Committee—and more particularly your Research Chemist, Dr. Key, and his Assistants—on this 3rd Report, which I find one of the most interesting and valuable Reports yet produced on this subject.

First of all, I would like to refer to a most important question of principle which is now emerging as a result of the cumulative work of this Sub-Committee and is exemplified by Prof. Cobb in his general Introduction. He draws attention to the fact that the work done by Dr. Key shows that the individual constituents of gas-works liquor differ widely in their amenability to biochemical oxidation, phenol lending itself most readily to destruction by biological agents when mixed in proper proportions with sewage. At once the mind of the man familiar with gas-works practice, turns to the question of modifying this practice so that this information may be utilized to the best advantage.

This is an excellent example of a principle on which I have insisted for many years, that the first line of attack on the problem of trades waste should be in the works producing the waste material. It is a most interesting thing that you have arrived at that point now. Another point of a similar sort referred to by Prof. Cobb is the attack on the difficult question presented by ammoniacal liquor. When ammoniacal liquor is mixed with sewage it may be negligible or helpful or even harmful in the sewage disposal operations, the precise effect in any particular case depending on a number of different factors. I alluded to this two years ago. The attack on the problem of the conversion of this ammonia to a suitable fertilizer by Dr. Key and his colleagues displays the skill and resource which marks all their work, and it is to be hoped that the enterprise of the Sub-Committee will be rewarded with the success it deserves.

With Dr. Key's method of confronting the work in hand as set out in his own introduction to his Report I am in complete accord. To his remarks on the merits of the oxygen absorbed from acid permanganate test I would add that the results from this test serve as a very rough working method of assessing the "strength" of gas liquors, but the detailed results of the careful work done by Dr. Key and given in the body of this Report serve to indicate the limitations of this test to people like myself, as Dr. Parker and others have found out before.

The "B.O.D." Test.

It is true too that the biological test known as the biochemical oxygen demand—the B.O.D.—gives fuller information as a criterion of the work that must be done in stabilizing the fermentable contents of different mixtures of sewage with gas liquors or their constituents; but Dr. Key has added further valuable evidence as to the large number of factors which operate in this test and that careful attention to detail is essential in carrying out the test and good judgment necessary when interpreting the result. He is therefore to be congratulated on recognizing that both these tests must be used along with the results obtained under working conditions if really useful information is to be obtained.

The Report is full of detailed information and only one or two comments thereon are possible. For instance the experiments on the behaviour of the several selected constituents of gas liquor, phenol, catechol, thiosulphate, thiocyanate, and ammonium sulphide yield results which I personally am very glad to have. Several years ago I pointed out, in discussing the results obtained at Cheltenham, that with a sewage such as that, a very small proportion of the gas liquor appeared to have a stimulating effect on certain kinds of biochemical reactions; and Dr. Key has shown the remarkable part which phenol alone may play in this respect. The difficulty which we have associated with the elimination of thiocyanate is confirmed by Dr. Key, while the variable rôle of ammonia and the poisonous action of ammonium sulphide are also indicated.

In view of the results obtained with the sectional filters, I would suggest to Dr. Key that when he has several such filters in mature action he should try the effect of superposing the top sections of the filters. The results will be by no means only curious, but under certain circumstances, of considerable importance in practice. One other suggestion to Dr. Key is that some results in this kind of work are often anomalous and puzzling, and if he would perhaps check the *p*H values—it is often done as a matter of routine—he would probably find it rather helpful.

Scientific Use of Existing Processes.

Mr. H. Hollings (Gas Light and Coke Company): Having been invited to contribute to this discussion I should like first to support Prof. Cobb's observation of the feeling among members of the Committee that in the recovery of ammonia the average practice of to-day may be still further improved by the scientific use of the existing processes and plant associated with the indirect recovery process. Prof. Cobb mentioned my name in this connection, but I should like to remind you that I have had the advantage of collaboration with Dr. Pexton in one case and Dr. E. W. Smith in another. I am referring to the First and Third Reports of one of the Committees which was merged a year or two ago in this present Committee. For notwithstanding these previous discussions I still feel that there are many cases where the principles which are there outlined need further patient application. From time to time, however, the Committee has considered various other processes of ammonia recovery which sought to

avoid the necessity of using sulphuric acid. Most of these processes have been rejected as unworthy of further experimental study, because of inherent economic or technical weaknesses. A decision was taken, however, to investigate by further experiment the possibility of making ammonium bicarbonate. Although I do not think that, except in cases where sulphuric acid is very costly, the manufacture of bicarbonate will show any large profit, I still think that this investigation should be pursued, as at the present time there are not available sufficient fundamental data to permit a final decision respecting the merits of the process.

Dr. Key is to be congratulated upon having devised a method of making the bicarbonate which, it would appear, may avoid difficulties inherent in earlier processes. For example, one early process was dependent upon the removal of the necessary carbon dioxide from the coal gas by means of dilute ammoniacal liquor. We have found that that is a slow reaction which is difficult to carry to completion in large scale practice. Dr. Key, however, causes gaseous ammonia and carbon dioxide to interact in the presence of water while condensation of the water is taking place. This arrangement may considerably accelerate the reaction. As Prof. Cobb points out, it will soon be necessary to decide whether this process should be developed on a works scale. If that stage of development comes I throw out the suggestion that it will then be necessary to devise means for removing the solid ammonium bicarbonate from the surface of the cooling jacket or coil upon which it will be deposited. The problem should not be insuperable, but I think it should have careful consideration before any large expenditure upon plant is incurred.

Removal of Phenol by Distillation.

Turning to the interesting note upon the removal of phenol from liquor by distillation, I may remark that in the laboratories of the Gas Light and Coke Company, we tried for some time to secure the preferential evaporation of phenols from effluent liquor. My colleagues, Messrs. Hutchison and Pexton, developed an ingenious method which worked well in the laboratory with pure chemicals, but which failed on a semi-commercial unit under plant conditions. We like to think that we have the courage to face our failures and see what can be learnt from them. It may be of general interest if you will allow Dr. Pexton to summarize the observations which he made in that connection.

Finally, may I refer to the valuable statement of working results of another dephenolating plant which Mr. Holton has made available to us. I believe that the liquor treated in this plant is very dilute and that I am right in assuming that the quantity of sulphate of ammonia represented by this balance-sheet is rather less than 500 tons. Thus, unless a very high price is obtained for the recovered crude phenol, we must soon arrive at a point where the net cost of this process per unit of sulphate of ammonia made represents something of the order of 30s. per ton. Mr. Holton does not tell us the price at which he sells the crude phenol, but I should like to know whether I have interpreted correctly his balance-sheet.

Dr. S. Pexton (Gas Light and Coke Company): Section IV. of the Report deals with the removal of phenols from ammoniacal liquor by distillation. It is well known that a film of oil on the surface of liquid water very materially reduces its rate of evaporation, owing to the mutual insolubilities of water and oil. Phenol is soluble in most organic liquids as well as in water, and some years ago, in conjunction with Mr. W. K. Hutchison, experiments were carried out to ascertain whether a film of oil floated on the surface of a hot aqueous solution of phenol would not act as a semi-permeable membrane—*i.e.*, would allow the evaporation of phenol to the atmosphere above the oil while preventing the evaporation of the water. Laboratory experiments were quite successful—*e.g.*, when dry air was streamed over a 1·09% solution of phenol in water, covered with a thin layer of molten vaseline, at 90° C. the outgoing air contained phenol and water vapour at partial pressures of 0·68 and 6·8 mm. respectively. These figures correspond to a value of n, used in the same sense as by Dr. Key, equal to 47·6, compared with the equilibrium value of 1·69 at 90° C. and Dr. Key's value of 1·83 at 100° C. In some experiments solid phenol condensed when cooling the air leaving the apparatus. These results suggested that in the presence of an oil film, phenol could be distilled from weak aqueous solutions with a minimum evaporation of 2% or 3% of water.

After investigating various filming agents, experiments were carried out on the semi-large scale using effluent liquor, and films of paraffin wax and of heavy lubricating oil. The experiments were a failure due to the frothing and disintegration of the film, making it quite permeable to the evaporation of water. There was also a serious loss of the material constituting the film. Both troubles were probably connected with the influence of impurities in the effluent liquor.

Concentrated Liquor the Solution.

Mr. P. Parrish: I have singularly little to say on the report that has been presented this afternoon. As a Member of the Sub-Committee I need hardly say that I endorse all that has been said in the Report, and personally I should like to express my congratulations to Dr. Key and his assistants not only for the valuable work which they have undertaken, but for the zeal and energy which they have displayed all along. I regard Dr. Key as one of the best research chemists associated with any of the multifarious activities of the Gas Industry. That, perhaps, is saying a good deal. At the same time, I do not always agree with him. Recently he had occasion to reply to a letter by Mr. Macdonald, of Motherwell, on the subject of the function of concentrated gas liquor plants in solving the effluent problem. Not a single word of what Dr. Key said can be refuted, yet the latter was written in such an extraordinary way that it created a false picture. There can be do doubt that the concentration of gas liquor in the automatic type of plant which has been developed in this country does definitely contribute to the solution of the ammonia effluent problem, and it does it in this way. The concentrated gas liquor plant works at an even rate throughout the 24 hours of the day, and can, indeed, work throughout the 365 days of the year. Therefore the quantity of oxygen-absorbing substances which are delivered to the sewer or to any other stream is relatively small in unit time; and that, of course, must be an important factor so far as the sewage works official is concerned. Moreover, there is devil liquor, because the devil liquor as you know it in connection with sulphate of ammonia plant is found in the concentrated gas liquor itself. I should here interpose one observation which is worthy of investigation. Not only does a very perceptible amount of phenol—impure phenol, of course—accumulate in the concentrated gas liquor, but there is quite a substantial quantity of pyridine bases. If Dr. Key wants to balance his synthetic gas liquor with the actual gas liquor, then he must take into consideration the pyridine bases, because they do constitute a very important factor in the absorption of oxygen.

Now, I am essentially a practical man, although a chemist; and I am perfectly certain that what gas engineers to-day are asking is what is the value of this report—does it lead us any further? I have said on more than one occasion—perhaps I said it too emphatically on one occasion—that the solution of the bye-product ammonia problem is to be found in the adoption of central works throughout the country at strategic points where concentrated gas liquor can be converted into ammonium products, not necessarily sulphate of ammonia, but a variety of ammonium products—where the economics stand a much better possibility of being a success than if you work in small entities. So convinced have I been that this is the only solution that I have been active in one or two ways in the establishment of schemes for centralization. These schemes will grow. They are growing, and they will continue to grow; and I venture to suggest that if the Gas Industry cares to reflect on the position in two or three years it will find that millions of gallons of gas liquor which were hitherto discharged to the drains or destroyed will be worked up into valuable ammoniacal products.

Manufacture of Ammonium Bicarbonate.

I only want to make one further observation, and that is on the subject of the experiments that have been conducted with regard to the manufacture of ammonium bicarbonate. There are other processes in the field. I myself have taken the liberty of patenting a process, because anyone who knows anything about the composition of concentrated liquor will know that about 75% is ammonium bicarbonate, and it is a very simple step indeed to convert the balance of 25% to ammonium bicarbonate by means which will be foolproof, which admit of operation on a large scale, and which are quite independent of any of the operations of a gas undertaking—and that, in my view, is an important aspect. There are, however, problems yet to be solved with regard to the product ammonium bicarbonate. We have to find out how to make it when it is perceptibly volatile, because ammonium bicarbonate, especially in a moist atmosphere does disengage ammonia very rapidly; but there are methods of filming ammonium bicarbonate during the process of crystallization which I think will overcome that difficulty. Another point that we must bear in mind is that ammonium bicarbonate is not as universally applicable as is sulphate of ammonia. Very large quantities of sulphate of ammonia in this country are mixed with calcium superphosphate, and it would be impossible to mix ammonium bicarbonate with calcium superphosphate with-

out causing a reversion or without forming a basic superphosphate, and in that case the acid used for the dissolution of phosphate rock is rendered to a large extent nugatory. I think these are important aspects, and they undoubtedly merit the attention of the Committee in the near future.

The Colour of Effluents.

Dr. A. C. Monkhouse: I should like to congratulate Dr. Key and his assistants on the necessary fundamental work which they have done on the biochemical oxidation of the constituents of gas-works liquor. Catechol has been chosen as typical of the higher tar acids, and it is shown in the experiments that not only was the oxidation rapid, but that the effluent was free from colour. One of the difficulties at sewage disposal works has been the presence of the higher tar acids in quantity in the effluent, because it imparted a slightly brownish colour to the final sewage effluent—the colour of pale tea. This was noticeable with effluents otherwise satisfactory as to oxygen absorption, stability, &c., the only objection being on æsthetic grounds —*i.e.*, the colour. I should like to ask whether Dr. Key considers the oxidation product of the higher tar acids or of catechol is more resistant to bacterial purification or is responsible for the colour-resisting treatment. This chemical oxidation is no doubt accentuated where the spent liquor is hot and contains lime and is exposed to the atmosphere in settling tanks. The results of the dephenolating plant at Partington are most encouraging, and Mr. Holton deserves congratulation on his enterprise. I should like to inquire whether the benzole remaining in the dephenolated liquor which is now recovered is of the same amount as previously reported. That is of some interest because, as Mr. Holton stated, that amount would appear as a loss at works where the indirect system of ammonia recovery is used, as at Partington.

Chemists and the Institution.

Dr. E. W. Smith: There is one matter, I think, that has been overlooked in this discussion, and that is the unique composition—I am on it—of this Committee. We have on this Committee representatives of the opposition. We have Dr. Calvert, Mr. Damon, Dr. Bailey, and Dr. Parker. They have been the most assiduous attenders at our meetings. They are occasionally in the majority, and any good work that has been done has been done very largely with the very close co-operation of these gentlemen with the greatest advantage to the Gas Industry. I think we ought not to overlook that.

This work has been split up into two sections—effluents and ammonia. It is significant that, with perhaps one exception, everyone who has taken part in this discussion this afternoon is a chemist and is not entirely eligible for membership of this Institution. That is significant, and I feel it ought to be redressed. It will come; but that is not the point of this discussion this afternoon. That does not meet with the approval of Mr. Alexander, I see, but the reason for raising it is that I would point out that the type of discussion we have had to-day is not necessarily conducive to the interests of the gas engineers here. They want to know in short-cut terms what is the effect of this work; what it means to us in our troubles. To those who are not technically interested in such phrases as catechol, *p*H values, and so on, it requires a good deal of patience to listen to such a long, entirely valuable and necessary, talk on work on this subject.

To sum up—and it has been done very well by Prof. Cobb—some years ago a great many gas undertakings were in serious trouble over effluents and how to deal with them, but to-day there is practically no problem, or at any rate no serious problem. Any gas engineer who is in any trouble has only to get into touch with either Dr. Key or Mr. Botley, and they will usually find a very simple way out of the difficulty. That was not the case three or four years ago. Owing, however, to the work of Dr. Monkhouse and Dr. Key there is now a solution for nearly all the difficulties relating to effluents. Looking across the room I see I have omitted one name, that of Mr. O'Shaughnessy, to whom our thanks are due for his collaboration. The problem has been solved by determining means for reducing the troubles and then showing how the same liquids can be put into sewers without causing any real inconvenience to the local authorities. The method of reducing troubles has had the effect of drawing the attention, particularly of the smaller undertakings, to the importance of reducing the oxygen in gas during production and also to the importance of putting air into the gas for purification purposes at the right point. This has indirectly had a very important result in the results obtained by gas undertakings.

Problems of an Administrative Nature.

The other subject dealt with by this Committee is ammonia. I am candidly not in favour of precipitate large-scale work being done in connection with the particular ammonium bicarbonate process patented by Dr. Key. I feel that the next stage is thoroughly to study other processes as far as it is possible and to evaluate all the processes brought out, on a balance-sheet; and if any one of these proves promising, then let us try that process whether it happens to be our own or someone else's. I do not know of any other process except the one mentioned by Mr. Parrish this afternoon, but I do feel that before we definitely concentrate on any one process we need to evaluate the known processes before we concentrate on this one. There are going to be many serious problems of an administrative nature if it is found that ammonium bicarbonate can be produced cheaply and can be used equally as well as ammonium sulphate. The Sulphate of Ammonia Federation used to be definitely a gas and coking industry controlled Federation, but to-day I think it is true to say that, owing to the quantity of sulphate of ammonia from these two industries being less than half what is produced in the country, these two industries do not control the Sulphate of Ammonia Federation; and in view of this fact what are going to be the problems facing the Federation? I think it is vital that we should get the support of the Federation behind the use of bicarbonate. I personally would suggest the formation of a Carbonizing Sulphate of Ammonia Association, and try to stand on our own feet.

One of the bitterest disappointments that I think some of us have had in recent years was the very small response which the Gas Industry, through the local Associations, gave to the suggestions of this Committee, as there were possibilities in centralization of concentrated ammonia works and the possible ownership, by the Gas Industry, of the necessary sulphuric acid works. If these two problems were tackled I am personally satisfied that we should have no loss in connection with the production of sulphate of ammonia in this country to-day. We have the reputation of being the most unified Industry in the country: from the point of view of the interchange of technical information there is no doubt that is so; but from the point of view of administrative collaboration and working together in all the essentials, there is nothing to be found of it.

Dr. Smith's Remarks Challenged.

Mr. O'Shaughnessy: I should like to make one remark concerning a statement just made by Dr. Smith, because I think it would be deplorable if such a statement were to go unchallenged. He said there is no problem in connection with the discharge of gas-works liquor. That is absolutely untrue, and so untrue is it that in Birmingham we are at the present time taking special steps in collaboration with the Gas Department to deal with that very serious problem at the Birmingham Gas-Works. I know of instances, and Dr. Smith ought also to be familiar with instances, of trouble due not only to gas liquor but also to the presence of other trade wastes. The quantity of gas liquor that can be admitted to the sewers depends on the other trade wastes in the sewage, so that any such statement as that made by Dr. Smith should not be allowed to go out unchallenged.

Dr. Smith: May I say that in Birmingham they do not distil their own ammonia, and the problem is not between the gas undertaking and the other people, but between the contractor and Mr. O'Shaughnessy. The gas undertaking does not distil its own ammonia.

Replies to the Discussion.

Mr. C. F. Botley, replying on the discussion, said: The members will observe that I have truants on my Committee, but I will deal with them in another way at another time. [Laughter.] But it is always interesting to hear these truants. I refer to Mr. Parrish and Dr. Smith. I particularly wish to emphasize the fact of the advocacy of concentrated liquor plants. It is perfectly true, as Dr. Smith has said, we were very disappointed some time ago when we sought to urge this on our colleagues in various parts of the country, that we did not get a better response. It was very disappointing. The same applies in some degree to sulphuric acid, the problem of which is bound up with the question of oxide of iron.

With regard to Mr. Parrish and the letter to which he seems to have taken exception, I am very sorry if it bore that interpretation to which he referred. The letter was prepared after consultation with my colleagues on the Committee, and it was left to me. I am responsible for passing that letter, and I relieve Dr. Key of all responsibility. That letter did not, or at any rate it was not intended to, condemn concentrated liquor plants. It was simply intended to point out certain facts which we thought we were up against.

An idea seems to be in Mr. Holton's mind that we were assessing very carefully the value which we put on sewage

works taking liquor. It was not intended in that broad sense, I can assure you, but it is very useful for those of us who have to deal practically with the difficulty. From the sewage point of view, what is the difficulty, because I say quite plainly there is often a purely imaginary difficulty? When Dr. Smith says there is no problem he means that we now understand what we are talking about, and we did not a few years ago. If people will only come forward with their problems, I am sure that with the help of Mr. O'Shaughnessy and others, and with our present knowledge, we can remove these difficulties or we can help to remove them. That is the sense, I think, in which Dr. Smith means it. We have provided a means whereby we can render this difficulty less acute, and we are making it less acute in actual fact every day, because we are constantly dealing with the difficulty in a practical manner. First of all improve the liquor from the sewage point of view, concentrate if you can; if you cannot, write to the Committee for advice as to what to do.

Dr. KEY in a more detailed reply to the discussion, said: I am very relieved that the bulk of the discussion has not been criticism but rather helpful suggestions towards future work. I can assure you that these suggestions will be carefully considered. Some of them, in fact, have been carried out already.

It was suggested by Mr. Holton that in view of our conclusions it would not do to install phenol removal plant, but I would like to suggest to him that it was a perfectly right decision in his particular case. I take care to point out on the first page of the third Section of the Report that, where the effluent or liquor is to be put into streams or rivers, then the thing to concentrate on is the removal of the toxic bodies; and the work reported only refers to those liquors which are admitted to the sewers. Where the liquor is admitted to the sewers phenol recovery is of very great value, because phenol is one of the most toxic substances in gas liquor to fish life, &c. While it would be possible to adapt existing plant to the proposed ammonium bicarbonate plant in some cases, it is too early, I am afraid, to say with any degree of certainty whether it could be adapted in all cases.

With regard to Mr. Parrish's question concerning the letter to the Technical Press, Mr. Botley has relieved me of the responsibility of replying, but I should like to say that in my opinion, and in the opinion of others, the paper against which the letter was directed gave a false impression in certain directions, and the letter was written with the sole object of correcting that false impression. The letter did not quarrel with the decision of the author to install a concentrated liquor plant. Actually, the letter commended that decision.

The question of colour has been raised by Dr. Monkhouse, and he has hit the nail on the head, as usual. We have carried out certain experiments on these lines, but it is too early yet to make any detailed statement; but I would say this as a piece of general advice. If you avoid colour in the effluent from the sewage works then you must have colour in your gas-works liquor. In other words, you must prevent that liquor being oxidized by the atmosphere before it is admitted to the sewers.

The PRESIDENT: There is one observation made by Dr. Smith with regard to the admission of chemists to the Institution to which I should like to refer, because I do not want it to go forth that the members of the Council or the members of the Institution have any objection to them, as chemists, being admitted. You must bear in mind, however, that at the present time under the terms of our Charter they are not eligible, unfortunately; and that is a difficulty we have to overcome. We are, however, thoroughly sympathetic, and should like to have the chemists as corporate members of our Institution, but under the present state of affairs we cannot do it. How we are going to get over it will be for the members of the Council and Mr. Alexander to consider and evolve a scheme, but nobody will be more pleased than I shall be when we get over that little obstacle.

Leakage in Horizontal Retorts

By A. H. CLUCAS, M.Sc., A.I.C., City of Leeds Gas Department

Mr. C. S. SHAPLEY (Leeds): I am afraid I am responsible for this further infliction of Leeds upon you, for two reasons —that I had some little hand probably in the inauguration of these Autumn Research Meetings, and that I am responsible for Mr. Clucas being in Leeds and giving us this thesis. This was the result of Mr. Clucas' ambition to go further in the chemical world; he had to produce this thesis, and I suggested to the General Research Committee that I thought the information he had got together was too valuable to be lost to the Gas Industry—that is to say, to the Institution of Gas Engineers. I am very glad to think that the General Research Committee considered it sufficiently important to place it before you at this Meeting.

Of course, Mr. Clucas has been working under a little handicap. He has not had a large amount of money at his beck and call to enable him to do perhaps all the research he would have liked to undertake. Neither has he had further plant installed to enable him to go further into the mysteries of this very interesting subject. Had he had unlimited funds he might have gone further than he has done, but I am satisfied with the results he has obtained, inasmuch as I can strike a balance sheet and show sensible £ s. d. improvements as a result of his work.

THE PROBLEM OF OLD PLANT.

When I gave my Presidential Address to the Institution in June, 1930, I had occasion to refer to the desirability of proceeding very cautiously before deciding to scrap even the oldest retort plant. This was with special reference to some of the horizontal retorts at our New Wortley Works. These retorts had worked 2200 carbonizing days and, as was customary after this length of service, the question of rebuilding was considered. However, we had a consultation, and as a result decided that these retorts ought to be capable of a further 300 days' working. I am pleased to say that our investigations were fully borne out; the retorts actually made gas for 2700 days before being rebuilt—a length of service which was a record for our Department.

I had in mind at the time that the continued working of old retorts might be at the expense of loss of therms due to coal gas leakage through the retort walls, and I considered it a problem worthy of investigation. A considerable amount of work was carried out by our Technical Staff, and I was sufficiently impressed by the encouraging results to consider that they might be of interest to the members of the Institution of Gas Engineers. A Report was prepared for submission to the General Research Committee, and this contribution by Mr. Clucas has been put before you to give, in a condensed form, some of the findings of our attempts with a view to elucidating this intricate problem.

At this stage I should like to say that it is very gratifying to me to be able to say that we have found the Reports and Communications of the Institution of Gas Engineers extremely valuable.

BENEFITS OF SCURF FORMATION.

We now know that newly scurfed retorts leaked very extensively, as shown by the report, and as soon as they were covered with a thin layer of scurf they became relatively gas-tight.

The benefits of scurf formation in this respect are, of course, well-known, but we had not previously realized the great extent to which we were dependent upon this scurf layer and it was of paramount importance to have some idea of the time required to produce this effective coating.

Even then, although the tightness of these retorts was mainly due to scurf, it was effected only by careful control of pressure conditions within the retorts.

The fact that leakage is at a minimum under such conditions is, I think, evident by the results that are being obtained from 27 beds of 8 retorts at the present time. Thirteen of these beds have already worked 2600 days. Six beds have worked 2040 days, and the remaining eight beds are new.

The straight coal gas produced has an average quality of 620 B.Th.U. (gross), and after dilution with producer gas and air for purification we are obtaining upwards of 79 therms of 470 B.Th.U. (gross) per ton of coal carbonized before washing, from which we obtain about 3 gallons of crude benzole per ton.

It came as a surprise that wet spraying produced negligible improvement in leakage.

I have not restricted Mr. Clucas in any way in giving expression to his own opinions in this report, and I think that he has perhaps been somewhat severe in his condemnation of spraying horizontal retorts for the purpose of producing gas tightness, but I think, however, that considerable modification in our methods of application is necessary. I consider it a problem worth pursuing, and with the help of the valuable reports of the Refractory Materials

Joint Sub-Committee I am hoping we may arrive at a method of spraying which will produce a more satisfactory degree of gas tightness.

When examining some of these old retorts during demolition, I found many points of interest, and a photographic survey was made. The selection given in the report will, I think, convey to you better than any verbal description, some idea of the condition of the retorts after approaching 3000 days' working.

It is stated in the summary that the report is a record of experimental work carried out to supply me with information concerning the economies of working old horizontal retorts. As a result of this investigation I am now satisfied that it is economically sound to work these old retorts; in fact, the term old is relative, and what we have called old retorts ought perhaps to be considered only middle-aged.

The knowledge of the fact that the retorts are made tight by scurf and by careful pressure control, together with the decreased resistance to discharging obtained by spraying, now enables us to work the retorts as long as they are structurally strong enough to withstand the wear and tear of the stoking machinery, or until they offer too much resistance to being discharged. Actually the effect is that the life of the retorts has been lengthened up to 75%.

The PRESIDENT: I should like to thank Mr. Shapley for the support he has given Mr. Clucas.

A USEFUL GUIDE TO OTHERS.

Dr. A. PARKER: In the report just presented, Mr. Clucas has dealt with a subject in which I have been interested for some years. His experiments have obviously been carefully made and, apart from the value of the work to the undertaking with which he is associated, the descriptions of the methods employed and the results obtained must serve as a useful guide to others planning similar investigations.

Mr. Clucas has referred to experiments which I and my former colleagues, Mr. Kerr, Mr. Howarth, and Dr. Monkhouse, carried out for the Institution in 1923-24. These experiments, described in the Twelfth Report of the Gas Investigation Committee, were made at the Windsor Street Works at Birmingham with the principal object of investigating the performance of waste heat boilers attached to ranges of continuous vertical retorts. They also included what were probably the first determinations of leakages of products of carbonization through the retorts of full-scale plant. A few observations on these determinations may be of interest to members of the Institution.

In the first tests described in the Twelfth Report an examination was made of the performance of a waste-heat boiler attached to a range of 32 retorts carbonizing about 200 tons of coal per day. When the results were analyzed it was found that the quantities of steam raised were greater than theoretically possible if the waste gases entering and leaving the boiler at the measured temperatures were derived only from the combustion of the producer gases. The quantity of carbon in the waste gases passed through the boiler was about 2300 lbs. per hour, or 300 lbs. more than the carbon gasified in the producers. There were two possible ways of accounting for this additional 300 lbs. of carbon. In the first place, gaseous products of carbonization of coal may have passed through the retort walls into the waste-gas flues. The retorts, which were constructed of panelled bricks, had been in operation for about five years and were due for resetting. Secondly, waste gases which had passed through the boiler and were on their way to the chimney may have leaked past a damper into a by-pass flue back to the inlet of the boiler. There were also certain sudden decreases in the temperatures of the waste gases in the flues from the setting to the boiler which required explanation. Measurements of the quantities of heat lost by radiation and convection from the boiler setting were therefore made and the boiler was used as a calorimeter. The temperatures of the waste gases at various positions in the flues were determined and many samples of waste gases and producer gas were analyzed not only for the permanent gases but also for water vapour. From the data so obtained simultaneous equations were constructed for quantities of heat, carbon, and water. From these equations it was found that approximately 100 lbs. of the excess carbon in the waste gases passed through the boiler were due to leakages from the outlet of the boiler past the by-pass dampers to the inlet, and about 200 lbs. to leakages from within the carbonization retorts into the combustion chambers.

The equations also proved that there were leakages of air into certain sections of the waste gas flues and a leakage of water into an underground flue. A leakage of 200 lbs. of carbon per hour through the retort walls was equivalent to a loss of about 7% of the carbon volatilized in the retorts. This leakage was also confirmed by the fact that 100 volumes of the waste gases, corrected for excess air, contained 0·8 volume less carbon dioxide than should have resulted from combustion of the producer gas. A difference of 0·8% carbon dioxide according to the table given on p. 14 of Mr. Clucas' report is equivalent to a leakage of 4·8 therms per ton of coal, or about 7% of the approximate amount of 70 therms of gas produced per ton of coal carbonized. When the retorts were cooled and examined it was observed that many of the panelled bricks were perforated. Leakages through the retorts of other settings at the same works were also assessed by comparison of the compositions of the producer gases and waste gases, and it was shown that the leakages increased with the length of time during which the retorts had been in operation. For example, the leakage with continuous vertical retorts which had been re-set only twelve months previously was less than 1%, and retorts which had been in operation for four years showed a leakage of about 5%.

These were experiments on continuous vertical retorts, where conditions are vastly different from those in horizontal retorts, and it would be interesting if a method could be worked out for getting the pressure changes within the retorts themselves. I suspect that in continuous vertical retorts there may be on occasions local pressures which are quite appreciable, possibly of the order of 1-in. water gauge, in certain sections of the retorts, especially if the coal is of a highly caking character and does not allow free movement of gases.

Mr. Clucas' experiments with horizontal retorts have shown clearly the importance of accurate control of pressures within and without the retorts to reduce to the minimum the pressure drop across the retort walls. They have also demonstrated the important part played by a thin layer of deposited carbon or scurf in reducing leakages. He has carried out a most useful piece of work, which should encourage others to follow in assessing the leakages from the retort settings at their own worth.

THE REWARDS OF PLUCK AND PATIENCE.

Mr. T. F. E. RHEAD (Birmingham): There is a large amount of painstaking work behind this report, and I must admire Mr. Clucas' pluck and patience in persisting with the research to the end. I agree with Dr. Parker that it does set a good example, particularly to works chemists, of the care, in sampling and gas analysis, which is necessary in drawing conclusions from such work. If Mr. Clucas were on my staff I should feel that I had in him an extremely reliable and accurate worker.

This sort of work, of course, takes rather a long time to carry out, and from the ordinary works routine point of view I do not think you could carry it out; you must have a man of research ability, and also two or three assistants, to carry it out. But it is very useful work to carry out, say, once or twice in the retort house to assess the various factors. Mr. Clucas has measured such matters as the effect of hot patching and spraying, and the effect of scurf. The direct method he has used is rather rapid—I was speaking previously of the gas analysis work—and by this direct method he has shown that spraying does not have a very great effect at first. By far the greatest effect is due to a small layer of scurf. He shows that a freshly scurfed retort will leak to the extent of 10%—I could support that view from my own experience—and that it takes from three to five days for a retort to get tight. It is a curious fact, but with verticals, on our test plant at Birmingham, we always reckon that three or four days must elapse before we can carry out a test under proper testing conditions. A freshly scurfed vertical retort gives a very lean gas.

I was particularly interested in Mr. Clucas' discussion of the texture of scurf. I do not know whether he has mentioned in the report the laminated effect which one sees on scurf, but in examining some horizontal retorts a few years ago we were very much impressed by the leaf-like nature of the scurf in the joints; we attributed it to the breathing of the retorts at the discharging and charging period, and we thought that probably one could count the number of charges into the retorts by counting the number of laminæ.

Prof. J. W. COBB: It is a special pleasure to me to welcome this paper from Mr. Clucas, not solely on account of its substantial usefulness to the Gas Industry, but as coming from one of my old students. If I may say so, it exemplifies in a very striking manner how the kind of training which is given at the University of Leeds in Gas Engineering is useful when the practical problems of industry have to be faced and solved. The work is thoroughly practical, both in conception and execution, but it is also thoroughly scientific both in its methods and in the discussion and interpretation of results. One pleasing feature of it is the manner in which Mr. Clucas has not only made himself acquainted with what has been already published on the subject, but has made the fullest acknowledgments to previous workers. It forms in itself

an excellent addition to the technical literature of the Gas Industry.

There is one thing more that I would like to say in connection with it. When one considers the importance of the Gas Industry from the standpoint either of the public service which it renders, or the amount of capital invested in it, the expectation is obviously justified that everything possible is being done in all parts of the country to effect improvements in the technique of both manufacture and utilization. It is true that provision is made for such centralized research work as has been undertaken and continues to be undertaken by the Joint Research Committee and its staff. It is true also that some of the larger gas companies, particularly in London, recognize to the full their responsibilities in this direction, as is evidenced among other things by contributions made to the proceedings of the Institution. But more than this is needed if a healthy spirit of progress is to be maintained in the Industry as a whole. Scattered through the gas-works of the country, there is rising a new generation of young Gas Engineers, some of them trained, I am glad to say, at the University of Leeds, who should be stimulated and encouraged to play their part in the development of their Industry. It will be a great pity if that encouragement is not forthcoming, if the young men to whom I have referred come to feel, from an over-developed sense of modesty or other reason, that nothing they can do is likely to receive appreciation. For this reason, apart from any other, I attach special importance to the acceptance by the Institution of this contribution.

Practice at Beckton.

Mr. K. C. Mead (Gas Light and Coke Company): Mr. Clucas is to be warmly congratulated on having submitted a report of great practical importance and originality.

I have been very interested to read his excellent paper, chiefly because we have been engaged in a regular system of leakage survey at Beckton during the past five years. The results which we have obtained during this period will, I think, be of interest, and confirm quite closely many of the figures given by Mr. Clucas.

He, however, appears to attach more importance to the method depending upon the analysis of waste gases, whereas we have preferred to make our routine leakage tests by direct measurement, using the indirect methods of leakage estimation as a check, or as an indication of the points at which more detailed investigation is advisable. The direct method has been found to be more convenient:

(*a*) The test is rapid, and the apparatus for making it quickly and easily set up and carried from one place to another.
(*b*) Single retorts can be tested.
(*c*) Retorts can be tested cold.
(*d*) The method is reasonably simple and does not rely on great accuracy in sampling and analysis.

As Mr. Clucas says, the use of waste gas for measuring the leakage is preferable, but we also found many practical objections to this method.

We found early that an orifice meter for the measurement of air representing the leakage occurring was more suited to a rapid test, and the apparatus now in use is light and portable and may be attached to any selected retort in a few minutes. A compressed air service is available in the retort houses, and suitable points have been arranged to which we connect the apparatus. Rapidity of testing is advantageous owing to the cooling effect of the ingoing cold air, which may introduce certain errors into the results obtained.

I would suggest that the accuracy of the method is affected by one or two more factors than are mentioned by Mr. Clucas—*e.g.*:

(1) Errors caused by cooling of the retort by the ingoing cold air are due to:
(*a*) Shrinkage of the material, causing opening of cracks, &c.
(*b*) Contraction of the gases originally held in the retort—the volume being made up by ingoing air, which cannot therefore be taken as a measurement of leakage alone.
(*c*) A progressive decrease in the viscosity of the air passing away.

I notice that Mr. Clucas takes his air leakage as a direct measurement of the gas leakage. Should not the air leakage factor be *corrected* to give the gas leakage, when absolute results are sought, in view of the fact that the viscosity of air and gas are not the same. There is a further complication, inasmuch as the temperature at which the gas leaks when the retort is working is different from that at which the air leaks when testing the retort. This affects both the viscosity and volume of the air and the gas. We have measured the temperatures at which gas and air leak, and find that, at the temperatures at Beckton, the differences in volume and viscosity cancel out, and that it is correct for all practical purposes to take air leakage as representing gas leakage.

There is also a further factor to be taken into consideration when testing retorts by this method—that is, that the presence in the retort of a charge of coal may exercise a sealing effect upon the retort material with which it comes into contact. We have made experiments to find out if this is true, and can state that the presence of a charge does reduce leakage, but to such an extent as to be negligible for all practical purposes.

A set of figures obtained from one particular retort was:

Before scurfing—retort empty—leakage index .	= 0·42
,, ,, ,, full ,, ,, .	= 0·39
After scurfing—retort empty—leakage index .	= 13·0
,, ,, ,, full ,, ,, .	= 12·3

The formation of CO by the action of the ingoing air upon the charge also will reduce the apparent leakage from the retort, so that the reduction of leakage by the presence of the charge must have been very small.

Mr. Clucas assumes a straight line relationship between leakage and the differential pressure across the retort wall. This is justifiable in the case of a retort in good condition where large holes or cracks are absent, or are carefully patched, when flows of gas (or air) through the retort wall may be assumed to follow the laws applicable to flow through capillaries, but is this allowable where large holes or cracks are present? Will not the leakage then be the function of the square root of the differential pressure? Evidence that fairly large holes are present in the retorts tested by Mr. Clucas is given on pages 27 and 29.

P. 27.—"Inspection of such retorts with pressure usually indicated definite points of leakage."
P. 29.—"The demolition of old retorts has shown holes and cracks of such dimensions that it is difficult to imagine any effective sealing by the deposition of scurf within them."

We have found, in fact, that any large hole in the retort will cause a *curve* when the chart is plotted. This being so, it may be asked whether all the Leakage Index figures given are strictly accurate.

With regard to the Leakage Index, we have preferred, in order to compare the leakage from various retorts, to reduce the leakage figure to leakage in cubic feet per hour per square foot of internal retort area. Perhaps Mr. Clucas could give the internal superficial area of the retorts he tested in order that we might reduce his figures to this basis.

Leakage is dependent upon several factors, among which Mr. Clucas has made special mention of the permeability of the retort material itself, and of the differential pressure across the retort wall.

Permeability.

With regard to permeability, Mr. Clucas suggests that this accounts for a small proportion out of the total leakage (p. 23). According to his figure (p. 23) 4/10 in. w.g. differential pressure will cause a leakage attributable to permeability of about 1 therm per ton of coal carbonized, and on p. 25, in the case of the 37 retorts with a leakage index of 1 or less, 4/10 in. w.g. differential pressure will cause a *total* leakage of about 4 therms per ton of coal carbonized—that is, the leakage due to permeability alone is 25% of the total leakage.

We have calculated, using figures given by Messrs. Clews and Green in the 23rd Report of the Refractory Materials Joint Sub-Committee, that the loss by permeability from a silica segmental retort is about 50% of the totál thermal loss.

The foregoing comparisons assume that the permeability of the material is not reduced by the deposition of carbon upon its surface, and by carbon infiltration into its pores. It is difficult to estimate to what extent this does occur, depending as it does upon the thickness, area, and permeability of the retort carbon.

At Beckton, the thickness and area of the carbon is small compared with the area and thickness of the retort wall. Few figures as to the permeability of scurf appear to be available, but there is a possibility that it may not be a great deal less than the retort material, in which case the above comparisons would still be reasonably correct, although, of course, the effect of carbon infiltration must still be taken into account.

The differential pressure across the retort wall depends as a rule chiefly upon the pressure within the retort.

Mr. Clucas has assumed that there is no high internal pressure; but is this correct? Although fully in agreement upon the extreme difficulty of measuring the pressure within the retort, we have definite evidence of the accumu-

lation of pressures of 3 or 4 in. w.g. under certain conditions, even though a slight vacuum is maintained at the retort mouthpiece. This can occur when the retort is heavily charged, or the coal is highly swelling, when pockets of gas are trapped along the length of the retort and the gas must force its way through coal which is in a dense plastic mass.

The size of the charge as mentioned has a definite effect upon this factor, and it would be interesting if Mr. Clucas could give the usual weight per charge in the retorts under review, or, better still, the percentage of retort volume occupied by a new charge.

That building-up of pressure may have occurred in his case is indicated by his remarks when he suggests that excessive pressures may have developed in a retort owing to tight packing of the coal in the middle portion of its length. If this packing had extended for any distance it is almost inevitable that pockets of gas should have been trapped with accompanying patches of high pressure.

Effects of Scurf Formation.

Mr. Clucas finds that leakage increases 40-150 times after scurfing. We have found this increase, however, to be about 10-40 times with silica and 5-20 times with siliceous retorts.

Mr. Clucas also shows that his retorts take 5 days to become tight again after scurfing, whereas our experiments have shown that normally our retorts are in good condition again after 2 or 3 charges—*i.e.*, 20-30 hours.

This, no doubt, is due to the different method of scurfing adopted. The retorts at Leeds were scurfed apparently at intervals varying from 80-200 days, and I take it were then scurfed quite clean, with the assistance of scurfing tools.

The procedure at Beckton, however, is to burn off carbon accumulations at intervals of about 14 days for a period of 10-12 hours (1 charge). By this method it is suggested that surface carbon is removed but that the small cracks and interstices in the material remained sealed up.

The use of naphthalene after scurfing is practised at Beckton. Tests have shown that the Leakage Index is reduced immediately thereby to a figure which is very little greater than that found before scurfing. We have calculated that the saving effected by using naphthalene in this way is equivalent to 0·3 therm per ton of coal carbonized, if the differential pressure is 1/10 in. w.g.

Mr. Clucas is unable to give any figures as to the effect of the ageing of retorts on leakage. This is unfortunate, as these would have made an interesting comparison with some figures given herewith.

In a retort house containing siliceous retorts we have found:

Age. Days.	Leakage Index.	
	Before Scurfing.	After Scurfing.
66	0·30	4·6
471	0·22	3·3
908	0·38	6·0

and in a retort house containing silica segmental retorts:

Age. Days.	Leakage Index.	
	Before Scurfing.	After Scurfing.
60	1·0	5·5
1260	0·8	21·0

It will be noticed that in the first case the leakage at 471 days is less than that at 66 days, but is again greater than ever at 908 days.

It is suggested that the decrease in the first case is due to carbon infiltration into the retort material, to the gradual sealing up of small cracks and holes, and also to the progress of slagging action in the material causing a decrease in its permeability.

Increasing age after this then enlarges cracks and holes to give the increased leakage noticeable in the tests made at 908 days.

We are now engaged in careful testing of a silica segmental retort house throughout its life. It has now been at work for ten months, and so far little "tightening up" has been observed.

Mr. Clucas' paper is valuable, as he again shows the necessity for the observation of certain points if the best results are to be obtained, and which I think should be emphasized—*e.g.*:

1. The avoidance of high pressures within the retort by—
   (*a*) Careful laying of the charge, and the selection of coal of a known degree of swelling.
   (*b*) Maintenance of a steady level of vacuum (or slight pressure) within the retort.
2. The maintenance of tight retorts by—
   (*a*) Careful construction and selection of material.
   (*b*) Careful and regular patching of all holes and cracks.
   (*c*) The presence of a film of carbon upon the retort walls, to act as an agent for sealing all cracks and small holes.

Control of Pressure.

Dr. S. Pexton (Gas Light and Coke Company): As one who has been much interested in the determination of leakage of gas from retorts, I should like to congratulate Mr. Clucas upon the thoroughness with which he has applied himself to this problem. The Leeds Gas Department are also to be congratulated upon having retorts which show a leakage of only about 2 therms per ton of coal even after 2700 working days. There is little doubt that the small leakage on this installation is due to the attention which Mr. Webb has given to the control of the pressure conditions within the retorts.

Fig. 2 on page 19 of this report is very instructive and shows what a heavy leakage is incurred when the pressure within the retorts is increased to 1 in. water gauge by sealing the anti-dips. This result was presumably obtained on retorts which had been subjected to the normal scurfing programme. Therefore, although it is demonstrated, later in the Report, that the presence of scurf on retort walls does very materially reduce gas leakage, it is nevertheless of great importance to maintain a minimum pressure difference across the retort walls even when scurf is present. Another feature of fig. 2 is the indication of considerable gas leakage when employing one ascension pipe only. The leakage in this case is probably due to what may be termed partially blocked charges—*i.e.*, the charge reaching so near the crown of the retort at some point along its length as to prevent free travel of the gas from the dead end of the retort to the open end. We have experienced this same effect and measured pressures of the order of 1 in. water gauge at the dead end of retort containing blocked charges.

With further reference to fig. 2, I think it would be invaluable if these experiments could be repeated over periods of sufficiently long duration to enable gas yields under the various conditions to be determined. How near would the deficiency in gas yield with the retorts under pressure approach to the leakages, as calculated from the reduction in CO_2 content of the air free waste-gases? The Gas Industry would be further indebted to the Leeds Gas Department and to Mr. Clucas if they would carry out this experiment.

Early History.

Mr. G. C. Pearson (Birmingham): Inasmuch as Dr. Parker has mentioned the substantial leakage (indicated by the 1923-24 experiments) from the retorts at Windsor Street Works, Birmingham, the Institution might be interested to hear how the conditions there have been very materially improved during the last three or four years. It is necessary to consider for a moment the early history of vertical retorts at Windsor Street, since their installation was commenced in 1912. The complete installation was finished about 1919, and the whole of these verticals were constructed for the production of coal gas without steaming. (Steaming was not introduced at the time the installation was commenced upon.) The producer capacity of these early retorts was found to be sufficient for a throughput of over 5 tons with non-steaming conditions, but after steaming had been introduced the throughput fell to the region of more like 4·5 tons. We recognized that there was need for greater producer capacity, but in all alterations of the settings, and reconstruction, that have taken place from then until now we have always been confined by the outside limits of the settings as originally constructed in order to use up the sub-structure and the coal hoppers and ironwork; and the only means we have had of increasing producer capacity has been by the introduction of silica, with the reducing of the combustion chamber and the retort monolith. We are now able to introduce a producer with a producer capacity one-and-a-half times or twice that which was put down originally, and by that means we have been able to increase the throughput about 1½ tons over what was found possible some years ago. The result of this increased throughput has been that the condition of the retorts as regards spalling and deterioration has very considerably improved. There is no extra temperature, probably, of the retorts,

but a greater available quantity of heat for carbonization. The number of therms per ton has increased 5 or 6, and the nitrogen has been reduced from 9 or 10% down to about 4½%. So that the increase of throughput has resulted in material changes not only in gas leakage but in thermal yield, and there are better results in every direction.

Mr. Clucas has given us an investigation into horizontal retorts, but if vertical retorts could be investigated as regards leakage it would be most interesting to consider the effect of increased throughput.

A "Simple Method."

Dr. R. Lessing (Consultant, London): Prof. Cobb's reference to the modern methods of investigation in the hands of the younger generation of gas engineers reminds me of some experiments I carried out nearly 25 years ago on this very problem of leakage through retorts. The question then arose of dealing with the retorts made on what was then the new plan of using coarser grog in mixing up the whole of the matrix, and therefore, being faced with a greater permeability in the retorts than had been used before, a necessity dictated by the need for greater refractory properties of the grog material. I considered at the time that a simple means of overcoming the leakage would be to fill the interstices of the retort material with carbon (Patent No. 12,119, 1911, see "Gas Journal," June 18, 1912, p. 905), and the experiments carried out, on horizontal retorts in a very small gas-works, consisted simply in charging new retorts when they were being started up and blocking up the ascension pipes. I took the bull by the horns, and did not want to rely—for reasons I will deal with—on the formation of scurf on the inner surfaces of the retorts themselves. To our utter surprise, it was found that for about 24 hours no rise in pressure on the inside of the retorts was apparent. After that time the pressure began to rise very gradually, and two or three days had elapsed before it became appreciable. The blockage of the ascension pipes was continued until a rise of about 24-in. water gauge was observed, and then, of course, the retorts were very tight indeed.

In order to explain the difference of such procedure from the mere dependence on forming a layer of scurf on the inner surface of the retort, I should like to point out that when allowing the gas to be driven under pressure through the body of the retort you produce a carbon deposit inside as distinct from the surface and the layer in the immediate vicinity of the surface. By that means, not only do you obtain better and more complete filling up of the body of the material of which the retort is made, but there is another phenomenon—*i.e.*, that those hydrocarbons which are the most difficult to decompose by thermal agents have a better chance of being decomposed. I am referring there to the differences between the heavy hydrocarbons and, say, ethylene and methane—particularly methane. The expedient referred to as being applied at Beckton, of using naphthalene, is a case in point. Naphthalene and benzole gives a different kind of carbon by primary decomposition, this carbon being of a more sooty nature than the hard carbon produced by the lower hydrocarbons. This point was referred to some 8 or 10 years ago by Prof. Mellor in one of his contributions to the Refractory Materials Research Association, and, of course, it is well known to chemists.

Safeguard Against Leakage.

It appears to me that at the present time, inasmuch as we have these refined methods of examination, which we had not available in those early days, the early experiments should be repeated, and on the lines of finding first of all the difference between the inner filling of the retort material and the mere superimposing of an outer layer of scurf. The experiments could also take into account the difference between the kinds of carbon produced by the various hydrocarbons used—and there is quite a likelihood that, although the heavy hydrocarbons produce a more sooty kind of carbon by their primary decomposition, this carbon, on further heat treatment, may be converted into a harder, a less removable material. The reason why this layer inside the retort should be of use is that the outer one on both sides of the retort is, of course, subject to either continuous or frequent removal; if it had any opportunity of forming on the outside of the retort—which it has not—it would be burned away by the combustion gases; on the inside it would be burned away whenever scurfing became necessary. But an inner layer will remain permanent, and that layer I would regard as a great safeguard against leakage.

I am fully aware that there might be a difficulty in the combination or the attachment of the scurf carbon to the carbon inside the material, but that is a matter for experimentation, to find out to what extent scurfing can then be driven without interfering with the inner layer of carbon.

This all refers to horizontal retorts. I am well aware that in continuous vertical retorts the case is not quite so simple, because there the temperature required to produce this layer of carbon would be available only in a certain zone which is subjected to higher heating. On the other hand, presumably—I am speaking without any definite information—the leakage in the less heated zones might be rather less than in the highly heated zone. I bring this matter forward because probably the time has arrived when experiments on the lines indicated should be resumed.

Determining Leakage.

Mr. Gilbert B. Howarth (Newcastle-upon-Tyne): In order that gas may leak from a retort, two conditions must exist. In the first place, it is necessary that there should be a perforation of some kind through the retort wall; in addition there must be a difference of pressure between the inside of the retort and the outside.

The two methods of testing approach these conditions in entirely different ways. The compressed air method gives a measure of the extent of perforation of the retort walls, but takes no account of the manner in which the pressures are adjusted. On the other hand, the gas analysis method shows whether leakage is actually taking place during the period of sampling, without discriminating between leakage caused by excessive perforation and leakage caused by excessive pressure difference. We know that Mr. Webb has paid particular attention to the control of pressure in his retorts, and this may well be partly the reason for the low leakage figures found at New Wortley in spite of the age of the retorts. It would be interesting to have comparative tests on new retorts.

Mr. Clucas clearly explains the uncertainties of the gas analysis method. The calculation depends on unreliable assumptions with regard to the composition of the leaking gases and vapours, and it is for that reason that the Gas Investigation Committee in their Twelfth Report preferred to regard this method merely as "confirmatory evidence" of the leakage calculated by other methods. Nevertheless, tests of this kind can be of very great value in showing whether retorts are being maintained and operated with reasonable freedom from leaks.

The remarkable effect of a few days' scurf in tightening the retorts is of great interest. Would it be possible at that stage to spray a coating of some suitable cement in such a way that scurf deposited could be removed by the usual methods without disturbing the first layer?

A word of praise must be given for the excellent photographs accompanying the Report. The Leeds Gas Department has for a long time shown special interest in photography as a means of recording progress on the works. Mr. Clucas has acquired considerable skill in the use of special lenses, plates and lighting, and the published photographs show what can be done in difficult positions.

Mr. R. N. Webb (Leeds), in response to the President's invitation to speak, said: It was not my intention to join in this discussion, because in my opinion Mr. Clucas has dealt with the subject exceedingly well. I have played, perhaps, the practical part in connection with this report. The date of its commencement coincided with an attempt we made at New Wortley to control the pressure conditions within the retort as far as possible; we were fairly successful in this, and as a result some fairly definite conclusions were derived and are included in the Report. The number of therms produced per ton has increased very satisfactorily, but we do not consider that we are yet anywhere near the maximum increase; we hope to effect considerable further improvement in the future.

Some of you may wonder why we lay stress on the discharge difficulties. The reason is that the discharge machines we have at Wortley were put in 20 years ago, and were intended only to discharge retorts with 8-hour charges. Since then we have increased to 12-hour charges, with the result that the extra pressure needed is rather more than the weight of the machines will allow us to use profitably. In discharging these retorts after scurfing—they were then very bad indeed—the machine simply rears up at the front. We use hydraulic pressure; you know that hydraulic pressure is either full on or full off, so that when the machine rears the man in charge cuts off the power, so that the machine descends very rapidly on the front wheels, with the result that the axle is broken. It was necessary to do something to alleviate that difficulty. The spraying of the retorts with a silica powder was intended originally to tighten the retorts; it did not have that effect, but it did relieve us very considerably of the discharging difficulties, and we have been able almost to double the working life of our retorts by that simple means.

In former days the difficulty of discharging retorts was

one of the factors which necessitated pulling them out and re-building them, and the saving in that respect alone on a fairly large works is quite considerable, and well worth the time devoted to this work. It was suggested to me this morning that this work might possibly occupy quite a long time, but I can assure you that it does not. The scurfing of the retorts is done in the old way. We allow the scurf to form, and, as you will note from the Report, in the various retorts it takes various times. We are going to experiment in order to find whether the method mentioned by Mr. Mead will effect further improvement, but I am of opinion so far that our method of scurfing is the correct one, when the length of life of the retorts is taken into consideration. We find that after 2700 or 2800 days the retorts are getting into the condition at which it is profitable to rebuild them.

Finally, I should like to add that during the preparation of this paper, and of the paper I presented two years ago, we have had the greatest assistance and encouragement from our Chief. There is no doubt that we shall continue our investigations in the future, possibly with the idea of presenting them again to the Institution.

Mr. CLUCAS: I feel very gratified indeed by the very kind way in which you have discussed this paper, and I have learned a great deal from the discussion. Some of the comments made will require careful consideration, and I hope to be able to make a suitable reply in a written contribution.

Refractory Materials

[24th Report of the Joint Sub-Committee]

Mr. FRANK WEST (representing the British Refractories Research Association): It is evident from a perusal of the report that satisfactory progress on many problems of interest, to both Gas Industry and Refractory Manufacturers generaliy, has been maintained, and I will go so far as to say that the standard of the achievement by the British Refractories Research Workers is comparable with many other societies who may be much more favourably equipped. A survey of the many investigations upon which reports have been submitted is an indication of the diversity of the problems of interest to the Gas Industry.

The work on the problems of hot patching and spraying, jointing cements, and the effect of carbon monoxide has progressed considerably, and the results to date should be of great value to the Industry.

The investigation of the effect of alkalis on refractory materials has revealed some striking effects in regard to the damage which can be done by alkali substances on aluminous and silica materials, and this work promises to be of primary importance in relation to the behaviour of retort materials.

It is gratifying to note that work is being commenced on the mechanical properties and reversible thermal expansion of refractory materials, for such investigations are definitely necessary for the better understanding of the limitations of refractories. The note on mottled silica bricks is of peculiar interest since it supports results obtained by manufacturers.

FLAKING OF CONTINUOUS VERTICALS.

One report of great importance is the consideration of the flaking of continuous vertical retorts. A general view appears to have been taken of this problem and according to the authors the major portion of the damage is caused by the scurfing operation. It is apparent that criticism may be levelled at some of the statements made therein, but as the subject is of such vital importance to the carbonizing industry and manufacturers of retort materials, it seems inevitable that users and manufacturers have each to contribute to the cure of this trouble, the former by carefully controlling the scurfing operation and the latter by adjusting the physical properties of the products to withstand controlled scurfing conditions.

It is interesting to note that the work in progress alludes to the standardization of the refractoriness under load test, and in this connection it has been suggested that the question of the introduction of a soaking period, at a definite temperature, may be worth investigation as being a more discriminating test than heating up to a failing point.

In conclusion, Mr. President, I should like to make a few remarks on the recent wonderful tour of the Institution in Canada and the United States of America, more particularly relating to refractory research. Mr. Green, as you know, was sent from the Refractory Research Association, and he and I visited many Universities, Research Institutions, and Ceramic Works during the trip.

All the Universities, &c., were equipped with elaborate apparatus, and I venture to say that if our investigators were let loose over there among such apparatus our Monthly Bulletins would not be large enough to deal with the results. I would say, summing up the whole trip, that we had a very interesting and instructive time, and I am sure it will be reflected in the future work of the British Refractories Research Association, and that the Institution will benefit in the long run in the special researches which are undertaken by the Association.

MECHANICAL NATURE OF THE DIFFICULTY.

Mr. HAROLD E. COPP: I think it is evident from this excellent report that considerable advantage is to be gained by co-operation with other industries which have similar problems to face as we have in the Gas Industry, and I think we are very fortunate in having such an investigator as Mr. Green, who is in touch with the whole subject from other aspects as well as our own.

At a meeting held five or six years ago I think I said that the flaking of retorts was due to heat transmission, at the zone of the retort where the temperature is constantly changing. I still believe that statement to be correct; but this report, in the section dealing with the flaking of continuous vertical retorts, gives five other contributory causes, any of which, or a combination of which, may represent the true solution of the difficulty. I have a notion—granted that we do get impregnation of scurf into the interstices of the retort material—that much of the difficulty is purely of a mechanical nature—*i.e.*, you have this variation of temperature and a layer of material within the refractory material, which may possibly possess a different coefficient of expansion, and, therefore, strains are set up every time there is a change of temperature.

The authors, in their epitome of the report, lay great stress on this question of scurf, and it can be inferred that they think this is the chief cause of flaking, although there are the other factors I have referred to. There would appear, however, to be some serious omissions from this report which may not have come to the authors' notice, and which it is thought might have a definite place in the consideration of this matter. The first is that the flaking is not progressive, at an even rate or any other; as the brickwork becomes thinner the flaking becomes less, and in time is almost erased. Secondly, almost invariably the second flaking is thinner than the first, and in cases where a third flaking occurs these flakes are still thinner. While it is agreed that the question of scurf formation and its removal has a very definite and important bearing on this subject, I think an equally important point is that of heat transference. The flaking generally occurs at the hottest zone of the retort. It follows, of course, that the scurf will be thickest at this point, because the cracking of the gas vapours occurs here. It may be argued that when the brickwork becomes thinner the temperature gradient at this point is greater, but it would appear that the rate of heat transference would consequently be greater, and, therefore, the new surface on the retort would be kept at a temperature nearer that of the combustion chamber. This would seem to be an explanation of the lessening of the flaking as the brickwork becomes thinner. I freely admit that very high local temperatures do occur during the scurfing period; it is obvious that they do, and they can be detected, of course, by means of the pyrometer.

I was amazed the other day, when examining some coals, to find one particular coal, containing a very high percentage of chlorides, the ash of which was of very low fusing temperature. We attempted to fuse this in a pure silica crucible, but the bottom of the crucible was almost entirely destroyed. There you have very clear evidence of

the effect of chlorides, and certain other materials contained in the ash, on pure silica.

I should like to thank Mr. Weston for the careful manner in which he prepared reproductions of flaked surfaces by taking plaster casts; and I would add that a careful perusal of this report will be attended with useful results.

Mr. Carder's Experience.

Mr. C. H. Carder: The only feature I want to comment on is flaking. My principal reason for offering any remarks is that from experience I rather disagree with an impression that may be created by the insistence of the Committee on the effect of periodic chilling, very slight in extent, on this flaking. We know, of course, that the flaking is very local, very selective in its incidence, and one cannot say with certainty that of a whole group of retorts any certain proportion will be affected. I find from my own notes that in an installation of 48 5-ton retorts, 7 were badly affected by flaking at 300-350 days, and 11 were affected at 1000 days. But when the two affected beds were let down for examination, for other reasons, after 1200 days no flaking was found on any other retorts on those same beds.

It is easy to make *ex parte* statements; but to corroborate my statement that periodic or intermittent chilling of the retorts is not a major cause I would instance an installation of 36 vertical chamber ovens which were in constant operation on gas making for 2297 days before being let down for examination. They were let down primarily for re-lining the cheeks of the producers, which were burned right through, and we found there was no spalling on any of the silica work on any of the chamber ovens. There was a certain amount of erosion on the bottom 3 or 4 ft. of retort, which was natural, considering the weight of charge, the length of time, and the fact that they were steamed for three hours before discharging. Those chambers were working on 12 hours' carbonization and 3 hours' steaming, so that the alternation of an entirely cold coal charge was frequent and persisted over a very long period without giving any indication of this flaking or spalling effect, as one would anticipate if the Committee's conclusion were correct.

The conclusion to which we did come as the result of very careful examination confirmed the emphasis which Mr. Green has laid on the question of scurf formation and removal. We all know, of course, as a matter of ordinary observation, that when scurf is burned off there is a certain shrinkage. The adhesion of the scurf to the surface of the retort necessarily means that the surface of the retort is subjected to considerable strain when that curling or shrinkage off takes place, and it is logical to assume that the thicker the carbon deposit the greater will be the stresses on the surface of the retort. It seems more than a coincidence that on the retorts where we found spalling our normal scurf cycle had been varied, for reasons which it is not necessary to go into now. We were working a normal scurfing period of roughly 5 weeks and then burning off under more or less normal conditions; with longer time than is normally considered everyday practice, to prevent the attainment of high local temperatures and local stress areas, the retorts had skipped two normal scurfing periods, and there was a period of nearly 15 weeks between scurfings. One can have a certain sympathy with shift engineers, who are anxious to remove this *bête noire*, but the retorts got overheated at the top, and with a thick layer of carbon on the most vulnerable portion of the retort the flakes were physically ripped out.

There is another point, perhaps a minor one, to which I might refer in connection with this, in view of the statement in the report that "Retorts or portions of the retort which receive a lower and less variable flue temperature are not, usually, subjected to the same degree of flaking." The normal operating flue temperatures of the continuous vertical retorts, in the affected zones, were between 1230° and 1280° C. The normal flue temperatures of the intermittent vertical chamber ovens to which I have referred were from 1330° to 1350° C., and, when making very special grades of coke for special purposes, reached 1380° C., but still we got no flaking.

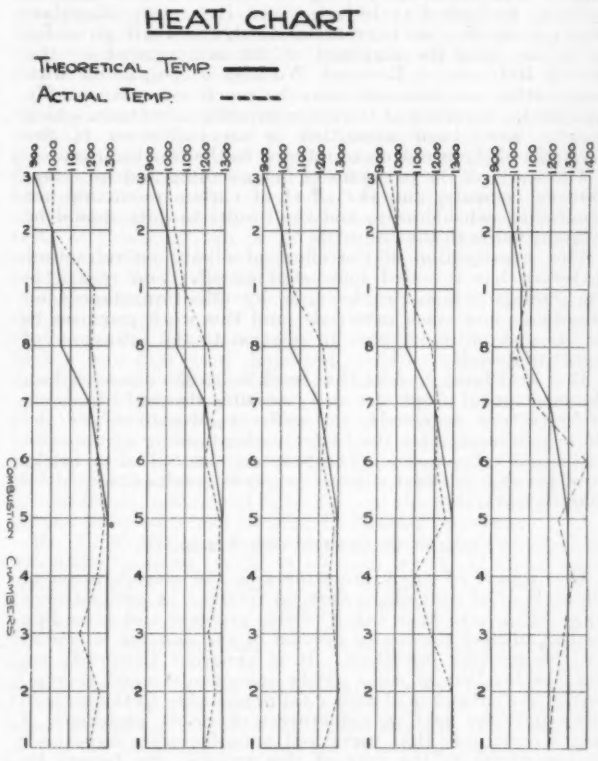
Views of Mr. Rhead.

Mr. T. F. E. Rhead (Birmingham): I should like to endorse all that has been said about the very valuable work that Mr. Green and his staff have done for the Industry. Do not think I am satisfied, but I think you will agree that we have here an excellent contribution, and extremely good value for our money.

The work on hot patching seems to me to be following satisfactory lines now, in that certain elementary conditions are being observed. The old method of using wet spray, as I have said before, I certainly do not agree with. I should like to say something on the question of spalling. I am not an advocate of either the periodic chilling theory or intense heating at scurfing times; at present I am sitting on the fence. I have observed, particularly in the Woodall-Duckham type of retort with vertical flues, that the spalling follows the division walls of the heating flues; it is very noticeable how it travels down quicker at that point than on the combustion flue wall proper. Another feature, which Mr. Green has pointed out, is that there is no serious flaking—indeed, I do not think I have seen *any* flaking—on the end walls; and a curious factor is that the scurf is usually thicker on the end walls at the corners even than on the major axis of the retort. It seems to me that further detailed examination, which I have no doubt will be given, of the formation of scurf will throw further light on this problem. The decomposition of hydrocarbons on the retort wall covering the combustion chamber proper would be expected to be quicker than that on the retort wall covering the division walls of the combustion chamber. It may be that in one case it penetrates further into the material than in the other case. However, I throw out these suggestions as matters which might usefully be considered, if they have not been considered already.

Need for Temperature Control.

Mr. J. Mitchell (Leicester): I am in agreement with the authors in their remarks with regard to flaking of continuous vertical retorts, and it is my opinion that the blame



Mr. Mitchell's Chart Showing the Need for Accurate Regulation of Temperature Throughout the Length of the Continuous Vertical Retort.

cannot always be attributed to the refractory material but is, in many cases, due to faulty scurfing.

A little more co-operation between the undertaking and the contractors will do much to eliminate a good deal of trouble in this direction.

It is also not fair to blame old settings for poor figures as some of my best results have been obtained from retorts 7 or 8 years old.

Some time ago, at a Manchester meeting, the advisability of giving careful technical supervision to the heating of retorts was emphasized, for unless the temperatures are properly regulated, satisfactory results cannot be expected. It has been my practice to plot curves representing the various temperatures obtained throughout the length of the retort, and from these it is possible to see at a glance those combustion chambers needing attention. I have two such charts here, and it can be readily seen from the varying temperatures that one of the retorts is not subjected to a uniform expansion and contraction, thereby damaging

and shortening its life. The temperatures used in these charts are all obtained by a reliable pyrometer.

Many engineers are of the opinion that high temperatures are necessary for the best results, but I am in agreement with the authors in advocating the careful control of combustion chamber temperatures to suit the type of coal and the scurfing operation.

The Author's Reply.

Mr. A. T. Green, replying, said: It is always delightful to reply to a discussion when no-one has trodden on one's toes particularly. I find that the arguments which have been brought forward to-day can very easily be brought into line with all that I happen to think, and therefore, I do not feel that I have any moral objection whatsoever to anything that has been said. I should like to thank Mr. Frank West, the Vice-Chairman of our Research Association—and, believe me, he keeps us very much in order—for the remarks he has made with respect to the work we are doing and also to our very enjoyable tour in America. It was very kind of the Institution to allow me to go—of course, I paid my whack [laughter]—and it was particularly encouraging to have with me Mr. West, who is a globe-trotter of renown, to show me round particular nooks and crannies of that vast continent.

The remarks made by Mr. Copp with respect to the flaking of retorts agree in practically every detail with those that I have put forward. Let me put it this way; as a research worker I am not supposed to have any bee whatsoever in my bonnet—I may have, but I am not supposed to—and it is very necessary that I should not be dogmatic at any time. I try to collect the evidence and assess its value in a rightful and honest manner. You will find that in the report practically every possible cause of flaking is put down—that is a dodge of research workers [Laughter]—but I have definitely laid emphasis upon what I consider, from the examination of specimens from retorts, to be the major causes. It strikes me that all that is necessary now is to ally our ideas of the influence of scurf adhesion, high temperature of scurfing, and stresses involved with Mr. Copp's idea of heat transmission, and probably next year we shall have something which will satisfy us, but probably will not satisfy you, on that particular point.

With regard to the influence of fused ash, mentioned by Mr. Copp, in causing the deterioration of a silica crucible, it would have been useful to have known the analysis of that ash; then we could have assessed its potentiality as a slagging agent. If it were such a low fusing ash it probably contained a fair amount of ferrous iron, and we know, in the examination of the bottom portions of a retort, what the influence of ferrous iron, together with the descending coke, can be on the thickness of the retort in the lower zone.

Mr. Copp and Mr. Weston have been particularly helpful, and Mr. Hardie has rendered great assistance by reason of the many retorts he has placed at our disposal.

Then Mr. Carder said he did not believe that chilling had much effect. Well, if I may go back to my safety valve and say that I did not wish to be dogmatic, I may say that I included that as one of the five causes but did not stress it at any time. Probably, therefore, you will see that I agree with Mr. Carder. It is surprising how one can agree when nobody has disagreed. [Laughter.]

Mr. Rhead does not sit on the fence; I know very well that he has very strong views on this question of flaking. I have had to listen to them, and I take it that if you have had to listen to any man you have formed an estimate of what he believes. Actually he has ideas on the same causes that we have given in our report. I should like to add that Mr. Rhead indicated to me, after we had commenced the work on the addition of silicon and aluminium to the cements for hot patching, that he had already experimented with these, and, therefore, he sent me some of his works reports indicating the nature of these experiments.

I find that Mr. Mitchell has definitely come to the same conclusion as we have with respect to the influence of the scurfing operation. There are no two ways about it; it is a most appalling operation and a most important one, and probably its significance has only been thoroughly realized throughout the industry during the last three or four years. It is not up to me to suggest what a schedule for scurfing should be. [Laughter.] It is up to the contractor [renewed laughter]; at least, I have always been led to believe that that is where the onus lies. Having worked more or less for a contracting firm at one time, I found that the onus did seem to lie in that particular direction. We shall have to have a variety of schedules, to suit different types of retorts and coals, because I am definitely of opinion that the type of scurf varies very considerably, its adhesion varies, and the difficulty of getting it away varies in consequence. It seems to me that the contractor has a mighty big job to satisfy all his customers with regard to all the variants in respect of the scurfing operation.

I thank you for the way in which you have received the report; your reception of it will certainly spur us to do better next year.

Behaviour of Cokes in the Open Grate

By Dr. E. I. LLOYD, A.I.C., F. BELL, and H. J. HODSMAN, M.B.E., M.Sc., F.I.C.

Mr. Ralph E. Gibson: I should like to say how much I feel indebted to the authors of this report for the very valuable information that is contained in it. It will add materially to our knowledge of the subject of smokeless fuels. The report, I think, shows very clearly that gas cokes produced by high-temperature carbonization can be made which are very satisfactory in the open grate, and that there is really no special need to adopt low-temperature carbonization with its disadvantages, its low gas yield, and higher costs. Gas cokes are superior to low-temperature cokes in output of heat, while they last longer, as is shown in the tables by their lower rates of combustion. Low-temperature fuels, moreover, are not entirely smokeless on account of the considerable amount of volatile matter they contain. The report is confined to the examination of certain cokes and does not give us any information as to the carbonizing conditions under which these cokes were produced. Since the good qualities of coke for domestic use depend largely on the conditions of carbonizing temperatures, weight of charge, blending, selection of coal, rate of throughput, &c., the report does seem to me to be, to that extent, incomplete. Perhaps, at some future time, we may be favoured with a further report dealing with these aspects.

I notice that the results from intermittent verticals seem to be inferior in some respects to those from continuous verticals, and I should like to know exactly why that is. Is it on account of the particular coals used in carbonizing, or the bulk density, or what other factors come in?

A Confession of Weakness.

There is one thing in the report that I cannot quite understand, and that is the large quantity of gas used for ignition, as shown in the tables. For example, the fuel in which I am specially interested is shown to require 12 to 14 c.ft. of gas for ignition. This fuel, however, is frequently tested for ignition, and it is not allowed to go out for sale unless it can be ignited with 4 c.ft. of gas. Therefore, I should like to ask the authors how the quantity has been determined. The authors are in favour of an open grate fitted with a gas burner, and this has been emphasized by Mr. Hodsman in his opening remarks. That, however, seems to be rather a confession to the general public that coke is not as good as coal. I have long held the view, and expressed it on many occasions, that the Gas Industry can provide fuel for the domestic grate in this country which is smokeless, easily ignited, which will radiate more heat than raw coal, and which will be in every way satisfactory to the consumer without the assistance of a gas burner; and I think this report confirms that view. Gas burners could very well be put into new grates, but we have to remember that all the existing grates have to be catered for, and I have in use in Liverpool a specially prepared coke of this kind, with free-burning properties,

selling at the same price as that of good coal; and it finds a ready sale. Many thousands of tons of this fuel are sold, and the sales are increasing rapidly. I have suggested to the Research Committee that a standard specification might very well be drawn up for fuels made by high-temperature carbonization dealing with such points as ease of ignition, kind and quantity of ash, radiating power, rate of burning, grading, &c. In my view such a specification would be useful, and a coke answering to such a specification should be called by a special name. It certainly should not be called gas coke, because gas coke for various reasons is not popular with the general public as a domestic fuel.

The authors have described in Part II. a method of increasing the ignitability of the fuel which will probably prove very useful in cases where the fuel cannot otherwise be rendered easily ignitable; but it remains to be seen whether that can be carried out on a large practical scale. It would involve the installation, I think, of a very considerable amount of plant. The diagrams show the great improvement that can be effected in ignitability, and I think the proposal of the authors will be very useful indeed.

Low-Temperature Carbonization in Coke Ovens.

Mr. R. B. Clayton (Manchester): Mr. Gibson has said he would like to know more about the methods of manufacture of the samples of coke tried, and perhaps I might just explain that sample 19 C, a coke oven coke, has been made on an experimental line of 100 tons without putting it on the market. It is not a question of advertisement or anything of that sort; it is only a question of information. This coke was made by a process patented by Mr. Powell in order to overcome the trouble of making low-temperature coke in coke ovens. The trouble in making low-temperature fuel in coke ovens—as I have found it in our coke ovens—is that if you try to push it it breaks up in the oven and it is impossible to discharge it to the bed. Mr. Powell has overcome that trouble by first charging a small layer of coal to the bottom of the oven, which he allows to carbonize for a certain period, and then the oven is filled up with the ordinary slack. Thus, when the charge is finished, it is possible to push it out without any trouble from breaking up in the oven itself. We have only tried a small quantity, and the coke we have produced was submitted to Mr. Hodsman for his examination, and the results are given in the report. Personally I consider it an extraordinarily good type. I have tried several grates in my office; indeed I am always trying grates, because I am a member of the Smoke Abatement Society, and I have always taken a great interest in smoke abatement. I was one of those who helped to form the Manchester Air Pollution Advisory Board on which Dr. Margaret Fishenden did such valuable work; and as one gets older one becomes rather an idealist, and looks forward to a solution of the smoke problem.

My idea of the smoke problem is that, although to a considerable extent this can be met by the use of gas and electricity, these involve the use of costly apparatus; and therefore it seems to me that the real solution is in a smokeless fuel. I have, as I say, installed many grates, and the fault of gas coke as I see it in my private capacity is that it is extremely difficult to keep "in," if you go out of the room. When you go into gas offices where these coke fires are demonstrated you always see a lovely fire which gives satisfaction, but my own experience is that if I leave my office with a lovely fire "in," when I come back two or three hours later I find it has gone "out." I also find extreme difficulty in lighting with a gas burner, and I would suggest that a gas burner should be made in the form of a bunsen burner, because I think the ordinary flame tends to absorb all the oxygen out of the gas in the immediate vicinity of the bottom of the coke, thus preventing the coke from lighting again, especially if there is a little ash in it. I also think that greater attention should be paid to the grates themselves. The ordinary grate is unsuitable for coke—*i.e.*, it does not give such satisfaction as coal gives. For that reason I think the grate should take primary place in our investigations.

Avoiding "Fliers."

Mr. F. Firth (Leeds): I would like to compliment the authors and the University of Leeds on a very fine piece of work combining highly scientific practice and observation with a scheme having immediate economic value to the gas engineer. Mr. Hodsman is a pioneer in research in the utilization of coke in the open grate, and the value of his work lies in the fact that his experiments are not confined to the laboratory but are extended to the practical conditions of the home; consequently his observations and advice will be very carefully studied by this Institution. The "Gas Journal," in an Editorial of Oct. 4, 1933, stressed the importance of the Gas Industry being the purveyors of low-temperature fuel, for which there is a market that is rapidly expanding. In this paper it is shown how a fuel having all the virtues claimed for the low-temperature product can be put on the market by a simple treatment of high-temperature coke. This is a discovery of first importance, and the influence it can exercise on coke sales makes the scheme worthy of the most serious consideration of the Gas Industry.

It might be of interest to suggest that gas undertakings which produce a dry coke either in verticals or by dry quenching using the Sulzer or similar process would be in the happy position to apply the coal dusting treatment without encountering those possible difficulties which one can visualize where a water-quenched wet coke would have to be treated.

With regard to some of the points in the paper, the relationship shown between combustibility in the open grate and the bulk density of the coke is particularly stressed, and the authors have shown that cinders only materially differ from the original coke in bulk density although their combustibility has increased. Could the authors explain how this reduction in bulk density occurs, and could the theory be made a practical proposition for improving the combustibility of the orginal coke? With regard to the weight of unburned cinders left in the grate after the fire dies down, would not the Authors consider this as an important index of the suitability of a fuel for the open grate? Would it be correct to interpret a low residue figure as some indication that a particular fuel could be rekindled from a lower temperature than a fuel giving a higher residue figure?

It is significant that fuels 5, 21, 14, and 16 leave the least residues. No. 21 is a house coal, No. 5 is an abnormal product, but 14 and 16 are low-temperature products. With the exception of No. 5, which is not available to the public, it is known that the others give entire satisfaction in the open grate. Nos. 14 and 16 are not the lowest in bulk density, but are the highest of the carbonized fuels in volatile matter. Would the authors accept that volatile matter in a fuel would be some compensation for increase in bulk density in influencing the combustibility of a fuel, and is there any relationship between this possibility and the coating of coke with coal dust, which has been demonstrated in the paper to increase combustibility?

Noiseless Combustion.

The authors mention in regard to Coke No. 8, that combustion occurs with a complete absence of noise, and this is a very interesting observation, in view of some work which has been carried out in Leeds in the causes of noisy combustion and "fliers" which are often met with when coke is burned in an open grate. For domestic purposes we felt that it was essential that coke should be silent in burning and free from "fliers;" and with this end in view we carried out our investigations. The result is that we have been able to demonstrate that noisy combustion and "flyers" are determined by the method used for cooling the coke after carbonization, and are entirely independent of the particular coal carbonized or the shale or moisture content of the coke. Shock quenching the coke with water produces noisy burning coke, on the other hand quenching with inert gases or air produces a silent burning fuel.

These findings were confirmed by a number of experiments of which the following are typical. A sample of noisy burning coke was placed in a retort and heated to approximately 900° C. and then withdrawn and air cooled. The result was a silent burning coke.

A noisy burning coke was loaded with extra shale picked out of the coke heap, placed in a retort, and heated to 900° C., then withdrawn and air cooled. The result was a silent burning coke. The addition of shale had had no detrimental effect in regard to noisiness on the finished product after air cooling.

A silent burning coke was placed in a retort and heated to 900° C., withdrawn, and water quenched. The result was a noisy burning coke with pieces flying out of the fire.

A discharge from a retort was divided into two portions, one was air cooled and the other water quenched. The air cooled coke was silent burning, while the water quenched portion was noisy.

It had been suggested that moisture in the coke is the cause of noisy combustion, so a parcel of air cooled coke was allowed to stand in a bucket covered with water for 12 hours, then allowed to drain to the point where the coke retained its moisture without dripping. On its being used to replenish a fire in the open grate the results were very interesting. No noise or "fliers" were observed and the fire actually burned appreciably brighter. The probable explanation is that the steam produced from the moisture in the coke improved the chimney draught. The creep of incandescence to the top of the added fuel is much

slower than the time taken to evaporate the moisture in the coke.

It would appear that the production of noisy or silent coke is one of annealing, but it would be of interest to carry the experiments further and find out the critical cooling temperature range and speed of cooling necessary to produce a silent burning coke.

Efficient and Attractive.

Prof. J. W. Cobb: The work which has just been described in this paper by Mr. Hodsman and his collaborators has been proceeding for some years in the University of Leeds. It has been based upon the assumption that if a solid smokeless fuel, such as coke, was to find a ready market, it would have to be both efficient and attractive when burning in the open grate. I need hardly point out that the endeavour to meet these requirements is being made by the coke oven and low-temperature carbonization industries, as well as the Gas Industry, and it is not a matter which can be neglected without serious loss. What has been wanting so far is a knowledge of what the requirements in a solid smokeless fuel really are, and how they can be given quantitative expression.

We have appreciated in recent years the importance of reactivity and of ignition points which can be determined with considerable precision, but they do not tell the whole story. The tests which Mr. Hodsman has carried out reproduce the actual conditions of use, and show very clearly how the differences in behaviour of cokes from different sources can be correlated with measurable properties of the cokes themselves. This is a step forward on which the authors may be warmly congratulated. Knowing what properties a coke ought to possess in order to make it an efficient and attractive domestic fuel, is not the same thing as producing it, but it is a first and necessary step and should be most useful to all who are seriously attempting the solution of this most important problem.

This paper will have a special interest to many old students of ours, as it has to me personally, because it is Mr. Hodsman's first contribution to the proceedings of the Institution, although his training, advice, and assistance have been freely given to all the workers in the laboratories of our Department at Leeds for many years.

Mr. A. F. Dufton: Speaking as one outside the Industry, perhaps I may be allowed to express the view that the Gas Industry is not tackling the burning of coke in the open grate in quite the most advantageous manner, and that it may be in some danger of losing the substance for the shadow. All good gas engineers, of course, should aim at improving the daily consumption of gas, and my attention was particularly caught by the statement in the report that "if it became standard practice in a city of the size of Leeds to light fires with gas, there would be a new daily load of at least half-a-million c.ft." Well, I hold that coke is the ideal fuel for the open grate, and I contend even more strongly that gas is not the ideal lighter for coke. There is no difficulty about burning coke in an open grate. I have burned no coal in my grates for the past six years, and my wife and maid think nothing of lighting the fire. Wood is the stuff to use; not many chips are required, but they should be fairly stout ones. I published a description of my coke fire in the "Gas Journal" in 1931 (Nov. 11, p. 434), and I gave an account of the performance of the fire. It is a wonderfully successful method of heating a room economically, and we should continue to burn coke even if it costs substantially more per ton than coal, because it is a better fuel. My suggestion, therefore, is to get people to use ordinary gas coke and to realize what they have been missing; and then when you have a surplus of gas due to the demand for coke, you can concentrate on the more difficult problem of using gas as a fire-lighter.

Mr. G. M. Gill: This report has interested me very much as I have done a certain amount of work on this subject myself. In the first place, I should like to make one or two small criticisms. The authors might have put the quantity of gas consumed in the form of B.Th.U. They only mention so many cubic feet. Also, in Table II., the rate of fuel consumed is given as 12 lbs. Is that on the dry or wet basis, and is the word "consumed" the right word to use, because I take it that the quantity consumed is 12 lbs. less the amount of unburned carbon set out in column 10 of Tables II. and III.? I also notice that the oven coke No. 20 is actually a low-temperature product. It is put among the oven cokes, and Mr. Hodsman referred to that. I would also like to know what was the size of the coke used in the experiments. I was rather disappointed that cokes made at high temperature from blends of coking and non-coking coals are virtually omitted from a careful examination, because, while Nos. 10 and 13 were both made from blends, in both cases the most important figures are omitted. Consequently it is impossible to compare the results from these blended cokes with the others.

Combustibility Improved by Blending.

In the work I have done I have come to the conclusion that there is no doubt the combustibility can be considerably improved if coke is made from suitable blends of coking and non-coking coals, and I am therefore sorry to see that these are virtually omitted from the report so far as giving full details is concerned. During last winter I ran scores of tests on cokes—high-temperature cokes—made from blends of coking and non-coking coals. The tests were carried out in two open grates; in fact, throughout the whole winter I used these cokes daily. They came from various gas-works in the country. Some were made in continuous verticals and some in horizontals, while there were one or two oven cokes. I came to the conclusion that, although one noticed rather surprising results, one can get a remarkably good free-burning coke made in that way. In my case I usually lighted these fires with paper and a bundle of firewood. Sometimes I used gas, and, like Mr. Gibson, I am surprised that the authors had to use so much gas to light these cokes. The quantity I found sufficient was a little more than Mr. Gibson's standard. It was usually about 5 c.ft. or 6 c.ft. of 500 B.Th.U. gas. As a result of these experiments I came to the conclusion that we can, by high-temperature means, make low-volatile cokes which will answer the purpose of most householders, at any rate, in place of coal or low-temperature fuels. If you make a careful analysis, as I have done, of the authors' Tables I. and II., I think you will come to the conclusion that the high-temperature cokes are better value than the low-temperature cokes, even if they were purchased at the same price. I take it continuous vertical retort cokes Nos. 1, 2, and 3 are of greater value to the buyer than the low-temperature cokes. The reason, no doubt, that low-temperature cokes are purchased is because of the greater ease of ignition; and that is a problem, as I see it, that is set before us—*i.e.*, to make high-temperature cokes that have better ignition qualities. I think this work should be followed up, and I would like to see a more careful examination made of the cokes from blends. I should like to congratulate the authors on the excellent work they have done.

"Reactivity."

Mr. John Roberts: I want to thank you for the opportunity of contributing to the discussion on this excellent report, and to congratulate the authors on the excellent work they are doing. In my opinion the word "reactivity" as it is now being used should be abandoned. We use it in two ways. We use it to mean reactivity with air—that the coke will re-act with air—and we also use it to mean that the coke will re-act with CO_2; and what happens? Take the case of furnace coke. One of the properties of furnace coke is that it should not be reactive to CO_2—*i.e.*, it must not be readily soluble. It must have a negative value, but in front of the tuyeres it must be highly reactive to air—*i.e.*, it must have a positive value—so that you have in that case, in describing the requisite properties of an oven coke, to say that it has a high reactivity and at the same time a low reactivity. Therefore it is absurd to use the expression in that way. What term, then, should we use instead of reactivity? What do we determine when we determine the reactivity of CO_2. We determine its solvent resistivity; and that is the expression we should use. We can then give it a positive value, the same as we can for combustibility or reactivity to air.

Mention has been made of the fact that cokes made from blends of coking and non-coking coals have better combustible properties than cokes made from straight coals, but there again it is a question of reactivity, and it is due very largely to the influence of the coal from which it is made. These non-coking coals are high-volatile non-coking coals; they are immature coals. Take the Warwickshire non-coking coals, for example. These coals have a certain property in their natural state; they are very liable to spontaneous combustion. In other words, they will re-act with air at a very low temperature; and the curious thing is that the char from that coal, when it is carbonized, retains that property from the non-coking coal, and this accounts for the reactivity of the coke itself. Not only that; it has been found that a coal of that description is also more reactive to steam in a continuous vertical retort than a straight coal. That was one of the first results that Mr. Britton observed at Hinckley when he took to the blending of slacks in continuous vertical retorts—viz., the property of spontaneous combustion; and this is really turned to account on blending it with an ordinary coking coal. I do not know whether it has been proposed to turn

that obnoxious property of coal to account, but this is one way of doing it.

Bulk Density.

The next point I want to mention is the bulk density. It is stated that cokes of a high bulk density are more difficult to ignite. This may be perfectly true in the case of the cokes which have been tested, but we cannot say that for smokeless fuels in general, and a wrong conclusion may be drawn from the suggestion. I have been interested for some time in the manufacture of a smokeless fuel at a very low temperature, and in this process there were produced cokes of the highest bulk density that I have known—42 lbs. per c.ft., considerably higher than any of those mentioned in the report. Others ranged from 34 lbs. per c.ft. upwards. These fuels were not at all difficult to ignite. They had been carbonized at a maximum temperature of 450°, and in some cases, not the higher bulk density cokes, but the lower bulk density ones, the volatile content ran to 23% at 950°; yet the fuels were absolutely smokeless. This shows that we cannot say a fuel is likely to be smoky on account of its volatile contents. It all depends on the type of fuel we are speaking about. I am speaking now of a smokeless fuel made in rotary retorts and which assumes the form of ovoids.

Another point I notice is that the cinders are more readily ignitable than the ordinary coke. We have found that to be the case for quite a number of years. Five or six years ago some of you may remember a product known as "Homite." With this we found invariably that the cinders ignited more readily than the fresh coke. What accounts for this? My view is that, in the first place, those coke cinders are absolutely bone dry. In the second place, the fuel has already been attacked the night before by the oxygen and the products of combustion, and the CO_2 has an action upon it. I believe Prof. Cobb has done some work on that matter. These cinders have been attacked by the oxygen in particular, and the first part of the coke to be attacked is the graphitic carbon, which is very difficult to ignite. The graphitic carbon is partly burned on the outside edges of the cinders. Further, the cell walls, having been attacked are now thinner than they were originally. Consequently they are more readily acted upon by the igniting agent; and however small the contribution of heat from that particle, when the fuel does become ignited in the aggregate it is very considerable. If you draw your fingers across or over the edges of a cinder you will find it has a feel very much like pumice stone; and this is due to the fractured cells in the whole mass, and you will find they are very thin and very sharp. We know that in the case of certain low-volatile steam coals it is always easier to start these burning by using cinders, and one of the Kent Coal Companies which marketed a smokeless steam coal with 16% of volatiles sent out a circular with an illustration showing how the fire should be lighted with cinders.

Finally, a word as to the Gas Industry becoming purveyors of solid smokeless fuel. I have urged that for several years, but I am rather afraid that if you have not already missed the boat the chances are that you will, because there is nothing in the world to stop the colliery companies themselves manufacturing a suitable smokeless fuel to-day in ordinary coke ovens.

Spongy Coke.

Dr. G. E. Foxwell: Reference is made in the report to spongy coke. During the last five or ten years we have had to deal with spongy coke, and it has come as a consequence of using high temperatures in coke ovens. When we had the old wide ovens and used temperatures of 1200° we never found this spongy coke, or we did not find it very much; but when we got to the narrow oven we had very spongy formation which comes from the top of the oven. I think it comes right from the top, and it is due to the pressure in the plastic layer of the coal. There are two plastic layers joined up in the middle, and these two layers exert a very high pressure when they join up. At that time you have heat coming from both sides instead of one side, and if you have a frothy coal and high temperature it blows the coal up in a froth. It is not very much in quantity, but it is a good deal in volume. That material does not easily burn. Mr. Hodsman found this, and therefore you cannot say that the coke will burn because it has a low bulk density, because nothing has a lower bulk density than that spongy coke. As a matter of fact, this material has a very thin film structure.

This brings us to the reason why coke No. 13 mentioned in the report will burn. I would like to underline the remarks made by Mr. Gill and Mr. Roberts. In fact, Mr. Roberts said so much with which I agree that I need hardly say any more. However, these coals from Leicestershire and Warwickshire which are non-coking coals give, when they are carbonized, a structure which is like charcoal. A high-temperature coke does not absorb charcoal. The difference is that 100 c.c. of high-temperature coke will absorb 4 c.c. of CO_2, whereas a coke made from the Leicestershire and Warwickshire non-coking coals can absorb up to 150, and I have found some considerably higher than that. It is these coals which I feel the Gas Industry should use more, because by doing so they can make a fuel which is equal to any Coalite.

At the Coalite Company's meeting this morning some remarks by Dr. Smith were seized upon to boost Coalite, but I do not think Dr. Smith meant what was attributed to him. In the low-temperature process as practised at the present time you have the iron retort, which is a very poor sort of thing to carbonize in. The Gas Industry gave it up many years ago because it is very unreliable. It has high repair costs, the scale of operations is small, and, generally speaking, there are many factors against it on the economic side. If you carbonize in a brick retort you know all about it and you carbonize under conditions which you know all about, and that, to my mind, gives the Gas Industry its opportunity, because I feel there is a movement on foot which is expanding more and more and creating a demand for a solid smokeless fuel. There are 40 million tons of household coal used in this country every year, and all that is our field. The handicap of the Gas Industry at present is that it does not sell sufficient gas to be able to make this quantity of coke, but you must consider it carefully, because the colliery companies will come along. It does not matter to them whether they sell the gas, because they can use colliery slack and have no transport charges for the material.

With regard to smokelessness, Mr. Gibson mentioned that low-temperature fuels are not always smokeless, and that is perfectly correct. On the other hand, gas coke is absolutely smokeless; but that condition will not apply to a tar-coal coke mixture. This is going to put tar into the domestic grate, while the low-temperature people take it out. Incidentally, while I am on this subject, I am surprised that we have not heard from Dr. Lessing about ash, because I do feel that the Gas Industry should use washed coal more than they do. Some do, but at any rate I do not think I am getting a coke made from washed coal, because the coke seems to contain about 15% of ash when it reaches me. There is another point which is very closely connected with using washed coal. We heard a lot yesterday about the possibility of taking sulphur out of the gas, but we did not hear anything about taking sulphur out of the coke; and surely there is more destruction from sulphur than there is from smoke.

"Chimney Loss."

Mr. H. G. Toogood: The report states, "Now the products of combustion from the fire often carry away at least 50% of this heat (the heat of the fuel consumed)." Therein lie two important factors. (1) If the authors can give us this percentage loss in each of their experiments it would provide most interesting and valuable information. If not, I suggest that this might be considered as worth while in any future researches. (2) The regeneration of these chimney heat losses is exactly where designers of open coke grates must look for immediate improvement.

As long ago as 1925 (see page 215, "Gas Journal," Jan. 27, 1926), discussing this subject, I stated: "There is nothing wrong with coke; it is the grate, or want of it, as can be realized by inspecting your local gas-works retort bench, comprising thousands of tons of brickwork heated and maintained heated at 1400° C., or a temperature far above molten metal over the mass of brickwork, by the efficient use of coke alone."

To-day, gas-works coke is considerably and very advantageously improved over that of eight years ago, and the publication of this report emphasizes the great need that exists for the boiling-down of the vast array of technical knowledge now available from scientific research, on the mechanism of combustion into the application to an improved construction of open domestic grate.

In the practice of retort houses, the shallow smaller sizes of coke fires, from time immemorial, have been advantageously and economically fed with hot coke, and I consider that the regeneration of the products of combustion to heat the coke before it enters the open domestic fire proper would have the effect of increasing (without fuel costs) the incandescence of the fire just those few degrees which mean so much when raised to the fourth power, as explained in the report. Moreover, I suggest that fuel already expanded and dried to a red heat would, when fed to the fire, burn better and noiselessly. I also suggest that, in order to give some quantitative information of the advantage to be gained, one or more of the charts be repeated on the same fires but fed with red hot coke.

Use of Insulating Refractories.

It is explained in the report how the insulating properties of the highly cellular vertical retort coke, by re-

taining the heat in the surface layers, facilitate the ignition of the coke at surprisingly low temperatures. Also the adequate use of insulation refractory is recommended in the construction of the grate, whereas later in the report the illustrations of the actual fires used in the experiments show the minimum amount of insulating material and the maximum employment of iron.

I suggest that the aim should be to omit both iron and normal firebrick as much as possible, and concentrate on porous insulating refractory, and to reduce the ironwork even to using an external portable gas fire lighter, as I have done for thirty years.

Part II. of the report refers to a method for increasing the ignitability of coke. When in America, we were shown several installations for spraying coke to render it less dusty and cleaner in use, but the claims that such spraying enhanced its ignitability were very moderate, so much so that at the Conference I inquired what hope there was of the discovery of some spray which would give to coke this twofold advantage. I am, therefore, greatly pleased to have my question answered so well and immediately on my return home. Judging from the report, this coal-painted coke ignites as freely as that expensive luxury low-temperature coke, in the search for which millions of pounds have been spent. I would like to visualize the appearance of this coal-surfaced coke, and would inquire if a sample is at hand?

The strength of this new method, I would suggest, lies technically in its simplicity, and commercially in the altered appearance of the fuel.

Experiments on the Works.

Mr. A. L. Holton: I only intervene at this stage to mention one or two directions in which I have been experimenting, because it appears to me that at such a research gathering as this it is very essential that not only should the academic side be stated but something should also be said by those who are experimenting in the works, because I think they can contribute a fairly useful discussion which the academic side will appreciate. With regard to the sale of high-temperature coke for domestic purposes, I think I can very modestly claim to be doing as well as anybody in the Provinces, and I attribute the success of the sale of our domestic coke particularly to the fact that we eliminate as far as possible any water content. I think I should be safe in saying that there is no domestic coke that goes out of the works which has a higher water content than 1½%. I know that brings the returns down under "coke," but I respectfully suggest to my fellow engineers and those of you who are selling water that you are doing the Industry a very great harm indeed. Because we eliminate the water our coke is very readily ignited, but here let me say that it is not so on all occasions. In this connection I would like to point out that the small works—and I do not speak of the small works in a deprecatory manner—are up against a totally different problem from the larger undertakings. For instance, I have it in mind that the smaller works draw their coal supplies from two or three sources only, and they can study them quite easily; but those of us who have the larger installations take our coal from 30 or 40 or 50 different sources. In my home we use coke entirely, and I am able to tell at breakfast time whether the coke has been readily ignited or otherwise—[laughter]—and I have really got a great deal of valuable information in that way. As a result I have found—and for the life of me I cannot ascertain the reason—that on odd occasions the ignitability of the coke is very much lower than it is on other occasions. Generally speaking, however, by keeping the moisture content low it is possible to obtain easy ignition. Incidentally, I must say quite frankly that the disintegration of coke has got it a very bad name, because carpets have been damaged due to fliers, and you must remember you are up against the housewife's problem in this matter.

The other point I wish to mention with regard to keeping the moisture content as low as possible is that in order to improve the ignitability of the coke I have carried out numerous experiments, without success. For instance, I have endeavoured to improve the ignitability of the coke by spraying in various oils at the bottom of the vertical retort. Although I have not been very successful with the oils that I have used, I notice in the report that coal dusting, &c., is hinted at. I purpose, however, now to adopt the line of endeavour of spraying the coke at the bottom of the vertical retort with a colloidal solution of oil and powdered coal. I do not know whether it will be successful—but whether it is successful or not, the results shall be passed on to our research chemist.

Intermittent Chamber Oven Coke.

Mr. T. Carmichael: The report states that coke made in the intermittent vertical chambers is the most difficult to ignite, and later on it says that the same material has the highest bulk density. I am very interested to know that the coke made in intermittent vertical chambers has a higher bulk density than even the coke oven product. Is that due to the greater height of the charge and the consequent weight of the charge? Further, do the authors place the coke produced in intermittent vertical chambers and that produced in intermittent horizontal ovens in the same category? In other words, in spite of the increased bulk density—which is a disadvantage—are the behaviour and qualities of these cokes similar in every other respect?

Mr. A. H. Lymn: The authors of this report—who are to be very much congratulated upon it—seem to be comparing the characteristics of coke made from coals which originated in very different parts of the country; and at the same time they appear to be trying to compare the apparatus in which these cokes are made. It seems to me that it would have been a very much more valuable comparison if the same cokes made in different retorts or other carbonizing plant were compared with each other. It rather seems to me, if I may say so, a vague comparison to compare a Yorkshire coal treated in a continuous vertical retort with a coal from Durham treated in an intermittent vertical chamber, and I do not think the comparison is a fair one. We ought, in addition, to have comparisons made of the cokes made from the same coals in different apparatus.

Mr. W. R. Branson: There are one or two points which have not been mentioned, but which, I think, constitute considerable advantages for the process suggested by Mr. Hodsman. First of all, in a gas-works we have to supply two coke markets which require distinct types of coke—viz., the closed stove and similar apparatus and industrial work generally, and the open grate. Any process which involves changing the type of coke produced in the whole of our plant is at a great disadvantage for that reason, whereas this process seems to have the advantage that only so much coke need be treated as is required for the market for the open grate, and we can sell the remainder for closed stoves, &c. The other point I wish to mention is that I think I am right in saying that processes which depend on blending non-coking coals with coking coals so increase the breeze content of the coke that there may be a loss even if there is an enhanced price for the coke sold. An increase of 5% in the breeze—which is practically worthless—is a very serious debit to the plant, whereas this process would seem to involve no increased production of breeze, and consequently a minimum loss.

Methods of Testing.

Mr. Hodsman, replying to the discussion, said: I think the number of questions that have been asked is so large that it will almost be necessary to leave any detailed reply until later, but there are one or two things which I think I ought to say now particularly as regards the technique or methods of testing. Mr. Gill's reproof that we have cut down the volume of gas for lighting instead of giving the heat value is a just one. Some of the other points raised are dealt with in the report. With regard to the lack of attention to blends I think I am entitled to point out that to run tests of this kind is a very laborious business, and, moreover, these tests can only be made as samples become available. The fact that the tests of blends are not given completely arises from this cause—viz., that the figures given in the report were made a good long time ago—at a time when our practice in regard to mechanical tests was not quite the same as it is now, and it would not have been possible to incorporate the results then obtained in the Table as given. I hope it will be possible to make tests of such blends when they are available—*i.e.*, when they become available to myself.

As regards Mr. Dufton's criticism about lighting coke fires with gas—and Mr. Gibson also mentioned this matter—I think we should beware of thinking that people will always continue to do in the future what they have done in the past. The whole tendency nowadays is for people to do away, if possible, with the old dirty and somewhat laborious operations of lighting a fire, and my own feeling is that people will not, in twenty years' time, be lighting fires with wood and paper.

The comparison between intermittent vertical coke and coke oven coke was mentioned by Mr. Carmichael, and I think I ought to say that the particular sample of coke oven coke is hardly representative of a first-class oven coke. Actually, I think it is produced rather for the domestic market than for furnace use.

The insulation of the fire was criticized by Mr. Toogood, but I think if he reads the text he will find that that fire was backed by a special heat insulating layer of wool slag. I think the other points can very well be answered in writing, and I will conclude by thanking the meeting for the attention that has been given to the report and the kind remarks that have been passed with regard to it.

XUM

Joint Council of the Junior Gas Associations

A meeting of the Junior Gas Associations' Joint Council was held in Birmingham on Oct. 23, under the Chairmanship of Mr. S. K. HAWTHORNE, M.Inst.Gas E.

The delegates present were: Messrs. W. J. Pickering (Education Representative); J. H. Wainwright and A. Hill (Midland Association); H. C. Sims, F. C. Smith, and F. H. Higton (London and Southern Association); T. H. Williams, J. Carr, and J. Alsop (Manchester and District Association); J. W. Wood, B. Thorpe, and J. R. Firth (Yorkshire Association); A. Tran and A. Bujnowski (Scottish Western); H. S. Bartlett, J. F. Rust, and R. S. Snelling (Wales and Monmouth Association); C. Bateman (Western Association); H. J. Risby (Hon. Secretary and Treasurer).

The CHAIRMAN, on behalf of the Midland Junior Gas Association, extended a hearty welcome to the delegates.

Copies of the minutes of the Joint Council meeting at Manchester on Oct. 24, 1932, having been circularized to all Councils through their respective Secretaries, it was moved by the CHAIRMAN that they be taken as read. This resolution was carried unanimously.

REPORT AND BALANCE-SHEET.

The SECRETARY AND TREASURER, reading his annual report, called attention to the extended indexing of Joint Transactions, Vol. No. 23. The balance-sheet, which was audited prior to the meeting, showed a balance in hand without any outstanding debts. Concluding, he expressed appreciation of the Secretaries and Treasurers of the respective Associations for their kind co-operation.

The report and balance-sheet were adopted, and a vote of thanks was accorded to the Secretary.

The SECRETARY read a communication from the Secretary of the Scottish Junior Gas Association (Eastern District) suggesting that their transactions might be included in the joint publication. In replying, the Joint Secretary stated that "we would be very pleased to include the transactions in the joint publication as an affiliated Association," and discussed the financial aspect. After considerable correspondence, a letter was received to the effect that their Council was awaiting the result of the Joint Council meeting, when Mr. Bujnowski intended bringing up certain points relating to the matter.

Mr. BUJNOWSKI stated the whole case for the Scottish Association, and mentioned that a definite ruling on the matter should result from their general meeting on Nov. 4.

S.B.G.I. MEDAL.

In regard to the award of the S.B.G.I. Silver Medals to Junior Gas Associations, an application had been received by the S.B.G.I. from the North of England Gas Managers Association (Auxiliary Section) asking to be included in these awards. The S.B.G.I. decided to include this Association if they became affiliated to the Joint Council, but a letter received from the Association stated that, not being an independent body, it was impossible at the moment to consider affiliation. It was decided by the Joint Council to table the matter pending future developments.

EDUCATION REPRESENTATIVE'S REPORT.

The CHAIRMAN, in inviting Mr. Pickering to submit his report, commented on the excellent work Mr. Pickering had done on behalf of the Junior Associations in the capacity of Education Representative during the past years, and voiced the hope of the Council that he would continue his good work in that capacity for many more years.

Mr. PICKERING said: The figures for the number of students who sat for examinations are practically the same as for the previous year.

Major Courses in Gas Engineering and Supply.

	1932.		1933.
External	94	..	105
Internal	331	..	312
Total	425	..	417

These total figures may be increased to 481 and 500 respectively for 1932 and 1933 by adding the number of candidates who sat for the examinations but whose results are not included for certain reasons, the chief of which concerns men who, having 2nd class certificates, re-sat and failed to secure 1st class certificates.

The figures for the Minor Courses and Gas Fitting are as follows:

	1932.		1933.
Gas-Works Practice	22	..	9
Gas Supply Practice	159	..	128
Total	181	..	137
Gas Fitting, total of all grades	1501	..	1494

The figures for 1932 were apparently peak figures, and 1933 indicates that the big increase of 1932 has been fairly well maintained. It is noteworthy that at present quite a number of men are coming into the Scheme who have good qualifications already in general science and engineering, and a further gratifying feature is the opinion of our teachers that the calibre of the students attending the courses has shown very decided improvement during the last two years particularly.

The Gas Education Committee's Report gives, in Appendix I., an interesting Comparative Statistical Schedule of Examination Candidates covering the past ten years. At the end of the first year, 1924, 36 internal students were presented by 4 approved centres for examination, and 24 external students were examined, a total of 60 candidates; while in 1933, 312 internal students were submitted by 26 approved centres for examination, and 105 external students were examined, a total of 417 candidates. There are now 43 approved centres for Major Courses in Gas Engineering and/or Gas Supply.

The Committee's report remarks that the tuition provided by the Technical Colleges throughout the country in gas subjects has improved appreciably, largely due to the Short Course for Teachers in Gas Engineering and Gas Supply which has been held annually since 1917, under the auspices of the Board of Education.

The revised edition of the Scheme Regulations has been circulated. One point worthy of note in the revised regulations is that concerning the percentage of marks to be obtained in examinations in ancillary subjects in the case of internal students. For a First Class Certificate a student must obtain not less than 40% of the possible marks in each of the ancillary subjects in each year of the course other than the final year. In the final year—*i.e.*, third or fifth—60% is required.

In conclusion, our best thanks are again accorded to all those concerned in the administration of the Scheme—to the Institution staff and District Committees in particular, and also to Mr. Creasey whose untiring efforts in so many sections of the work of the Scheme will soon be to some extent affected by his retirement.

A very hearty vote of thanks was accorded Mr. Pickering.

The CHAIRMAN, confirming the success of the British Industries Fair Junior Gas Associations' meeting, thanked Mr. Higton for his untiring efforts to ensure the complete success of this important event, and expressed a hope that the next visit would again receive the whole-hearted support of members of all Associations.

NEXT MEETING.

Mr. BARTLETT, on behalf of the Council, extended to the Joint Council a hearty invitation to hold their next meeting in Cardiff.

Mr. SNELLING supported this invitation, which was unanimously accepted.

NOTES ON PLANT AND PROCESSES

Specific Gravity of Gases.

A new publication has just been issued by Messrs. Alexander Wright & Co., Ltd., of Westminster, S.W. 1, entitled "Specific Gravity of Gases," the ostensible purpose of which is to interest those who are potential users of apparatus for testing the specific gravity of gases.

It is something more than a catalogue, and treats the whole subject in broad outline of application and in more or less detail as to apparatus. Though the firm have made gravitometers for a great number of years, in recent times they have concentrated on the compensated type, as a result of their experience pointing to the necessity for an instrument continuously recording the specific gravity of gas being corrected automatically for variation from N.T.P.; otherwise the record reflects variations due to temperature and barometric pressure. A special point is claimed of this automatic compensation, and it is stated by the makers that the instruments dealt with in this publication are the only ones on the market to embody such automatic compensation. It is to the gas manufacturer that the gravitometer should appeal to a wide extent, and this publication will serve its purpose in bringing to notice in general outline the advisability of controlling the specific gravity of town gas and the means that are available in the Simmance patent gravitometers for securing continuous registration of specific gravity to the greatest degree of accuracy under all atmospheric conditions.

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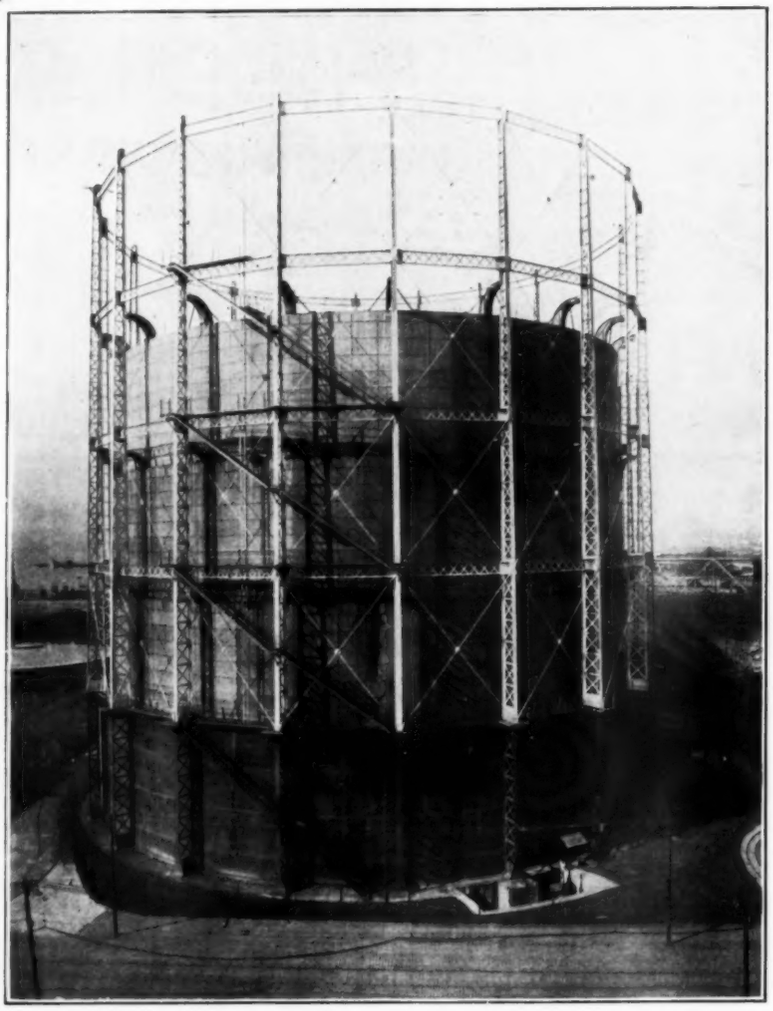

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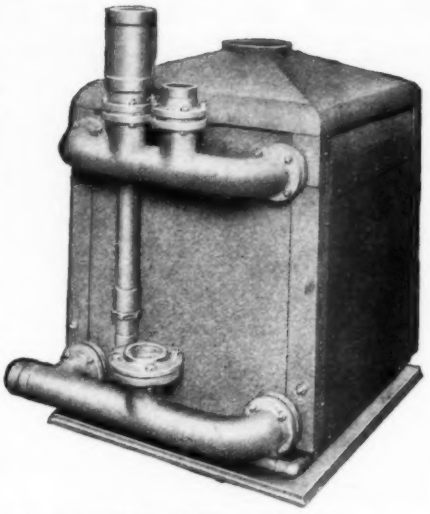

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British Road Tar Association

ADDRESS BY SIR DAVID MILNE-WATSON, LL.D., D.L., THE PRESIDENT,

At the Sixth Annual Meeting on Nov. 8.

The results of combined effort in the pursuance of a high objective, and the weight given to the Association's representations, are bearing fruit, as signified by the fact that British road tar is enhancing its reputation and is making steady progress in public favour. I feel it would be appropriate to-day to ask you to visualize with me a wider field of combined effort, bearing particularly on the depressed coal industry and national prosperity. The gap between these two points is being filled by the carbonization of coal, whether in gas-works or bye-product coke ovens, and the main theme of my remarks is to draw your attention to the appalling waste of our great national asset—coal, and its products—and to ask for a wider public appreciation of the immense potentialities of the carbonizing industry.

British Coal Industry.

Amidst the depression from which our basic industries are suffering, probably nowhere is there to be found a matter of more serious concern than the condition of the coal industry. This country was the pioneer of coalmining, partly because of the great natural advantages which its principal coalfields possessed, but perhaps more important still because British invention and enterprise led the way in applying coal to the uses of the human race. Industrial Great Britain was created by coal. By adopting improved and more scientific methods of using it, I believe it is by coal and its scientific presentation to the consumer that prosperity may again return. At the end of the last century, Britain's sovereignty in the field was undisputed. Since then, however, our coal industry has suffered increasingly from two principal causes—firstly, from the development and resultant competition of other coalfields in the export markets of the world; and, secondly, from the replacement of coal by other sources of energy, and in particular oil and oil products.

It is in meeting this competition from oil, and in placing coal in a more acceptable and convenient form of light, heat, and power, that the gas and bye-product coking industries can act as an indispensable medium of distribution, in addition to which the valuable bye-products of coal are conserved for national use and advantage. It would be no exaggeration to say that an extension and fuller appreciation of the carbonization of coal is a definite step to a return of national prosperity.

The Carbonizing Industry.

The alternative to burning raw coal is to carbonize it in gas-works or coke ovens as a raw material, so that its full elements—its purified essence in the shape of gas, and its solid smokeless fuel constituent in the shape of coke, together with an imposing number of important residuals—are preserved. The carbonizing industry, therefore, renders valuable service to the country by making available for every ton of coal treated a higher percentage of potential heat value than any other method, and reduces to a minimum the expenditure of human energy required for the conduct of operations necessitating the use of heat. There is yet a further conservation of energy resulting from the carbonization as opposed to the combustion of coal, the conservation of human life and health, time, property, and the energy derived from bright as opposed to gloomy surroundings, in the abatement of the smoke nuisance.

Gas.

The gas-works of to-day, whose primary object is to produce a gas suitable for distribution at the lowest cost, can claim to return to the public 85% of the heat energy of the coal treated. A steadily growing quantity of gas produced in coke ovens is also being distributed and utilized. No one can study the present industrial tendencies without coming to the conclusion that the great advantages which the use of gas offers will carry more and more weight as time goes on, and that its use in industry will grow in ever increasing amounts. The Gas Industry has long been pressing for release from the shackles of obsolete legislation, and we hope that the day is not now far distant when we shall be given the opportunity of meeting competition on equal terms.

Coke.

Coke can always be substituted for raw coal without any loss of efficiency and with the important social advantage of doing away with smoke. The preparation of first-class coke such as is now generally available necessitates the use of cleaned coals, the blending of coals to secure the right texture, and the choice of the most suitable sizes of coal for carbonization. As the result of research, the consumer of coke, both industrial and domestic, is now able to get exactly the material best suited to his needs.

Primarily, the bye-product coking industry was established to supply metallurgical coke as an essential raw material for the manufacture of pig-iron, but increasing outlets for the coke are now being found in domestic and general industrial requirements. It is a matter of gratification to us all that the present economic stress is promising to lead to a radical rehabilitation of the iron and steel industry, on which the prosperity of the bye-product coking industry so largely depends.

Surely, since it must be in the national interest to make the fullest possible use of our great national asset, coal, as a raw material for an increasing number of industrial and domestic purposes, far from being hampered in our development, we should be encouraged by every means in the power of those in authority to fight the battle for coal in those spheres where the products of coal are subject to intense competition from materials of foreign origin.

Benzole and Liquid Fuels.

In recent discussions on the subject of home-produced motor fuel, it seems rather to have been overlooked that Great Britain already produces upwards of 30 million gallons of motor fuel from coal per annum. Benzole Mixture is to-day one of the accepted national fuels, and up to the present is the only motor fuel derived from British coal which is available in commercially important quantities. Home-produced motor fuel is a product of the War, for it was to find a new market for the huge output of benzole, which during the War was absorbed in the manufacture of high explosives, that Great Britain first seriously looked to her own home resources for motor fuel.

From coal mine to carburetter is no idle dream. When we recall that yearly we import over 900 million gallons of refined motor spirit from abroad, we are but inviting a proper appreciation of the vast potentialities of home-produced motor fuel. So long as the present situation remains, our dependence upon predominantly foreign sources of supply for so vital a necessity as motor fuel will remain a source of weakness in time of peace and of grave danger in the event of war.

Another fuel derived from the carbonization of coal which is being used to a limited extent for motor vehicles is creosote oil. The wider application of creosote oil, however, is the direct consumption under boilers as a fuel oil in place of raw coal.

Gas as a Fuel for Motor Vehicles.

The production of oil from coal is but one of the methods by which it is hoped to find new markets for coal, and I want in passing to make a short reference to the use of gas as a fuel for the propulsion of motor vehicles. The question can as yet only be said to be in process of transformation from the experimental to the practical stage; but it is noteworthy that the recent Budget gave encouragement to the use of compressed town's gas on road vehicles. During the war the possibility of using gas for this purpose was successfully demonstrated, but it has long been recognized that high pressure gas in steel cylinders must take the place of the flexible bags used at that time. Such cylinders have now been evolved, and the disadvantage of their weight is compensated by the saving of cost in the use of gas as opposed to motor spirit for the range within which such vehicles can operate.

Tar.

In any consideration of the bye-products of coal, it would indeed be difficult to exaggerate the importance of tar.

XUM

The public may possibly be tempted to think of tar only in connection with road work, and it is perhaps necessary for me, therefore, to draw attention in passing to its wider significance in modern industrial life. The 2 million tons of crude tar which are produced annually in this country from the carbonization of coal form a vast chemical storehouse from which we derive an ever-increasing range of products essential to civilized life—such as ammonia, dyes, medicines, oils, explosives, scents, the sweetening medium of saccharine, the carbolic disinfectants, and pitch. These are a few of the derivatives from tar.

Road Tar.

There remains road tar. It is less than a quarter of a century since the first specifications for road tar were issued by the Road Board. We need thus only look back to a very recent past, and particularly the last few years, to appreciate the enormous development and improvement in the preparation and use of tar on our roads. This, as you know, is the prime function of our Association. We in this country have only about one motor vehicle to 30 of our population, whilst the U.S.A. have a proportion 1 to 5, and yet we have almost exactly the same number of vehicles per mile of surfaced road. If we are to make up but half this deficiency in the use of motor vehicles within a measurable number of years, clearly something further will be necessary in the way of road development, construction, and maintenance.

British coal through British road tar has an important part to play in the great road programmes which must inevitably be undertaken in the near future, but the experience of the last decade gives me redoubled confidence in the future. So far at least as the roads are concerned, the coal product is gaining ground. Compared with ten years ago, nearly double the quantity of tar is now used on the roads, and we have achieved this success in the face of the keenest possible competition from a product of foreign oil-bitumen. British tar has to-day made it possible to travel in safety, immune from the danger of serious skidding accidents, for thousands of miles in Great Britain, on roads that are British throughout—the stone from British quarries, the slag from British furnaces, the tar derived from the carbonization of British coal being the paramount materials. As the result of experience and enterprise, British tar is now meeting every requirement of the road engineer, and is available throughout the country in sufficient quantities to meet all the demands that may be made upon it.

General.

The total amount of coal at present carbonized is a very appreciable part of the coal production, and the value of its products tends to enhance the national value of that coal. It is high time, however, that it became generally recognized that the products of carbonization are not produced in isolation. They are produced in relation to each other, and in scientifically determined quantities. Broadly speaking, a strong demand for one of the products necessitates finding a market for all the others. The gaseous and solid fuels, together with the products and bye-products resulting from the carbonization of coal, are standardized and highly efficient. The machinery for marketing these fuels and products is both extensive and progressive, and behind it all is the research and experience of a great industry.

Fuel and transport form the basis of all operations in an industrial country. The return of national prosperity is the goal we are all seeking to attain. I believe that the carbonization of coal and the conservation of its invaluable resources and products are essential steps to a return of national prosperity. The great carbonizing industry is at the country's service—let the country use it, with a real and genuine appreciation of the perseverance and ceaseless activity of one of its most enterprising and progressive industries.

Exhibition and Cookery Demonstrations at Cannock

Considerable interest has been aroused recently among the people of Cannock and district by an ambitious exhibition of modern gas appliances and a series of practical

cookery demonstrations by gas, held at the Queen's Hall, under the auspices of the Cannock District Gas Company, Ltd. It was the first exhibition of its kind to have been held in the district for something like thirty years, and afforded local people an excellent opportunity of seeing for themselves the progress that is being made in the Gas Industry.

Several well-known manufacturers of gas appliances co-operated in the exhibition, and on each side of the hall were attractively-arranged stands showing the latest developments in modern gas usage.

Twice daily cookery demonstrations were given by Mrs. M. A. Fielden, M.C.A., U.F.C.A., ranging from cakes and rolls to a full dinner menu.

A model gas-works showed the manufacture of gas stage by stage from raw coal to the finished product, while an interesting demonstration of flood-lighting by gas was provided at the front of the hall.

The exhibition was in every way exceedingly well arranged and reflected considerable credit on the Gas Company, who are to be commended on their enterprise.

The exhibition was opened by Mr. S. E. Loxton, Vice-Chairman of the Cannock District Gas Company, Ltd.

Sir John Ferguson Bell, J.P. (Derby), another Director of the Cannock District Gas Company and the former Vice-

Chairman of the late Brownhills Gas Company (now amalgamated with Cannock), was also present.

The business resulting from the exhibition is stated to be very satisfactory.

Society of British Gas Industries

AUTUMN GENERAL MEETING

The Autumn General Meeting of the Society of British Gas Industries was held at the Hotel Metropole, London, on Thursday, Nov. 9, 1933, and was preceded by luncheon at which the President of the Society, the Rt. Hon. Earl FITZWILLIAM, K.C.V.O., occupied the chair.

LUNCHEON SPEECHES.

The Loyal Toast having been honoured,

Mr. H. E. BENNET said it was his privilege to propose the toast of "The President." "I am certain," he said, "you are all in whole-hearted agreement with me when I say we are fully conscious of our good fortune in having Lord Fitzwilliam in our presidential chair this year; we do appreciate the time devoted to our Society by a man of so many interests, to whom time is a matter of very great consideration. It is his own phrase that having sat in the House of Commons for eight years he ought to be well qualified to speak about gas, but he has other qualifications of more substantial merit. Most of you know that as the owner of the South Yorkshire Chemical Works he has a very large plant in Yorkshire and has been closely identified with high-temperature carbonization for many years; he is one of the originators of the Gas Grid in South Yorkshire, and now sends between 5 and 6 million c.ft. of gas per day to Sheffield and the surrounding towns.

"Having this large interest in gas, Lord Fitzwilliam is no doubt aware of the State-aided and rate-aided competition from electricity that the Gas Industry has to meet; it seems that the Government has become wedded to electricity; and if, as I believe, it was originally supposed to be wedded to the public weal, then this second marriage is simply sheer bigamy. Even worse, gentlemen, by the advent of the child, the electrical grid, I think it is clear that this unnatural union has actually been consummated; it is too late for anyone to forbid the banns, but let us hope that if opportunity arises Lord Fitzwilliam will contribute towards the annulment of the marriage.

"It means a lot, to a body of business men like ourselves, to have the assistance as our President of so eminent a public man as Lord Fitzwilliam, and I have much pleasure in giving you the toast of 'The President.'"

GAS BLOWN TO WASTE.

Earl FITZWILLIAM, in acknowledging the toast, thanked them for the way in which they had accepted it. He could assure them that his period of office as President of their Society was one to which he was looking forward with the greatest interest, because he had studied gas closely in his home county, and he hoped to gain a great deal of experience in associating with them. He remembered a few years ago, when going home night after night through Sheffield and Rotherham, being struck by the enormous amount of gas which was being blown to waste and burnt in the atmosphere from the high-temperature production plants. It should have been harnessed and distributed to the public, and a great deal of money could have been obtained from it. So they in Yorkshire had set about connecting up the gas undertakings in one big Grid Scheme into which they put this gas and distributed it throughout the West Riding. The system was only in its infancy, and as time went on gas must assert itself in the home life of the people, and they would have nothing to fear from the State aid which was being given to the electric grid. As to progress, they had evidence of this when leaving any big town by an arterial road, along which they would see hundreds, even thousands, of modern houses springing up where fuel was going to be utilized; and he could not help thinking that this was a healthy augury.

Earl Fitzwilliam said he hoped to have a very happy year of office, and he was aware that he was succeeding a very distinguished gentleman who had inducted him at the beginning of the year. He did not know whether they were going to have a really successful year as regards trade generally, but if they could gain any indication from the orders they were getting for gas and appliances which his friends told him they were receiving—and there appeared to be a definitely increasing demand—it showed that trade had turned the corner and was making a genuine advance.

DISTINGUISHED PAST-PRESIDENTS.

Mr. E. J. FOX, in submitting the toast of "Past-Presidents," said he supposed that no society had ever had a list of twenty-two names so distinguished in public affairs, in science, and in industry as the names which figured as their Past-Presidents. They were proud of these Presidents and grateful for the help they had given to the Society in a moral capacity and in every other direction. In fact, the success of their Society was undoubtedly in no small measure due to the assistance they had been able to gain from their Past-Presidents. On that occasion they had two respected Past-Presidents with them—the Rt. Hon. L. S. Amery and Sir David Milne-Watson. It was his pleasure to couple with this toast the name of Sir David Milne-Watson, and he was sure that while they all thanked their Past-Presidents for what they had already done, they were all looking forward to hearing from Sir David of the progress of the Industry at the present time. There was nobody who had done more in recent years for the advancement of the Gas Industry than Sir David.

Sir DAVID MILNE-WATSON, on rising, said that he felt a great honour had been bestowed upon him considering

THE PRESIDENT.

THE RT. HON. EARL FITZWILLIAM, K.C.V.O., C.B.E., D.S.O., LL.D.

Earl Fitzwilliam has for long been closely identified with high-temperature carbonization, and is the owner of a very large plant in the South Yorkshire Chemical Works. He was one of the initiators of the Gas Grid in South Yorkshire, and sends 5 million to 6 million c.ft. of gas per day to Sheffield and surrounding towns. He has been responsible for a great deal of experimental work with regard to the production of oils from shales at low temperature. His experiments with regard to oil from coal were interrupted by the war in 1914. Earl Fitzwilliam was extra A.D.C. to the Viceroy of India (The Marquis of Lansdowne) from 1893-4; Member of Parliament for Wakefield, 1895-1902; served with the G.H.Q. Staff in the South African War, 1900, when he was awarded the D.S.O. He was Lord Mayor of Sheffield in 1909, and acted as Departmental Assistant to the Director of Transport at the War Office from 1914 to 1917, receiving the C.B.E. in 1919. Earl Fitzwilliam is Deputy-Lieutenant and a Justice of the Peace of Co. Wicklow and LL.D. of the University of Sheffield.

the long list of distinguished names referred to by Mr. Fox. This list included names of distinction in politics, science, and business. It was always a pleasure, continued Sir David, to attend functions of the Society of British Gas Industries, and he felt it a great honour to be chosen to respond to this toast. All of those present were not, by the nature of things, 100% in the Gas Industry. The proposer of this toast, for instance, supplied pipes for uses other than those of the Gas Industry; and Sir David remarked how exceedingly glad he was to have the opportunity of showing how much he appreciated the co-opera-

tion which existed between this Society and the Gas Industry proper. They could not exist without each other. The plant and appliance manufacturers could not exist without the suppliers of gas, while the Gas Industry could not exist without the suppliers of the plant and appliances. He hoped that one of their foremost endeavours would be to continue to work together.

Joint Action Necessary.

Sir David said he was particularly glad that members of their Society had visited America and were joined by members of the Gas Industry. If ever there was a necessity for joint action it was to-day. Many of them had probably read the article in *The Times* that morning in which Sir William Ray, M.P., who was recently appointed as Executive Chairman of the British Electrical Development Association, outlined some of the plans of the Association to stimulate the demand for electrical energy throughout the country. But Sir David assured them that the Gas Industry would rise to the occasion efficiently. There were many things that electricity was suited for, but it could not do everything, and it could not do what the Gas Industry and the coke oven industry—and they were allies—could do in regard to the production of bye-products. It could not provide tar for the roads, nor creosote for timber, nor scent. The electrical industry claimed to be prepared to do a great deal to revolutionize industry, amongst other things in the cost of power; but he had recently got out some figures, which showed as an example that in the building of a ship the amount of electrical power used was only 1% of the total cost, so that any improvement in that direction could only very slightly affect the cost of building a ship. He did not want them to think he was disparaging the advantages of electricity, but it was up to them to take other measures and meet the competition by means of sound propaganda and efficient service. They were not ashamed of their record. He had just been told that in leaving London by road for the North one passed through no less than 10¾ miles of gas street lighting in addition to the gas used in the houses on that road—and this was a load for which the electrical industry claimed a monopoly.

Proceeding, Sir David mentioned that he was passing the Building Centre in Bond Street the previous afternoon and noticed a slogan in the window to the effect that "Electricity for the modern kitchen, saves more than it costs." This was worse than a cross-word puzzle, and was an example of the kind of propaganda they had to meet. He admitted that this particular slogan had given him much food for thought, and therefore no doubt it had served its purpose, but he thought the Gas Industry could invent a slogan equally delusive!

It was up to advocates of gas to show there was no rival to the Gas Industry in supplying fires, furnaces, and cooking facilities. Electricity was out to ruin the Gas Industry. Were they going to see their Industry ruined without a great struggle? Whatever the Government had done in the past—as they thought, mistakenly—the Industry hoped it would be induced to see that the ring was kept clear in the future and leave the two industries to fight out the issue as a commercial proposition.

Mr. Bennet, in proposing the toast of "Our Guests," remarked that it was not their custom at this Autumn Meeting to have any guests, the occasion generally consisting only of their own members and Past-Presidents. It had been arranged for him to read a paper at this Autumn Meeting on the subject of the visit to America. Since this was arranged they had been to the United States and Canada, and now in presenting this paper he found himself dealing with the most hackneyed subject in the Industry. But it had resulted in one piece of good fortune, and that was that it had enabled them to invite to their meeting all the members of the Institution of Gas Engineers who had been members of the delegation. He was very glad to see so many present who brought back to him such happy memories of the visit. They had with them Mr. F. P. Tarratt, the leader of the delegation, and no one could have been a more popular leader. He had borne the strain very well in spite of having to speak so frequently while in America.

Mr. Tarratt said it gave him extreme pleasure to respond to this toast. It was nothing unusual while in America, he said, to speak two or three times in the same town. But he had had a very good time, and no man could have wished to lead a better team. Excepting for one member who "fell by the wayside," they all returned in good form. They saw a great deal and made many friends, and Mr. Bennet had made as many as any of them. Mr. Bennet had certainly worked very hard and had made an honest endeavour to inquire into all matters affecting his own Industry. It gave him great pleasure, concluded Mr. Tarratt, to be there that day, where he saw many friends, for the Society of British Gas Industries were firm friends of the Institution of Gas Engineers.

The General Meeting.

The General Meeting was then held, when the chair was occupied by Mr. H. E. Bennet, in the absence of the President, Earl Fitzwilliam, who was called away to fulfil another engagement.

Mr. Bennet said that it had been their practice to present a half-yearly report to the members; but there were so few matters to put before them that he would condense them into a few remarks.

It is satisfactory, he said, to report signs of a general improvement in trade, especially in the iron and steel industries, which is shown by improved banking and railway returns and reduced unemployment figures. The Gas Industry is holding its own in spite of competition, and if the restrictions which at present hamper it were removed by Parliament—as we all hope they will be before long—further progress would undoubtedly be made. It is satisfactory to know that during the time of bad trade of recent years our members have given one another mutual trading support as far as has been possible, and it is hoped that this policy will continue.

Growing Membership.

Our membership, continued Mr. Bennet, is steadily growing, seven new firms having joined this year; it is hoped that all members will do their best to introduce new members and thus strengthen our Society. Our members fully recognize the importance of research and spend a large amount annually on development and research work.

Arrangements are now well in hand for the Gas Industries Section of the British Industries Fair at Birmingham in 1934, in which we are taking an active part in co-operation with other bodies in the Gas Industry and the Birmingham Corporation Gas Department. The Joint Industrial Gas Exhibit, which was arranged this year by the British Commercial Gas Association and organized and staffed by some of the leading gas undertakings, was an outstanding feature of the Gas Industries Section. It will again be arranged at the 1934 Fair, but on a much larger scale. The Joint Gas Conference, which has been very successful in previous years, is again being held, and the Gas Industry Inquiry Bureau provided by the Heavy Industries Section of the Society in conjunction with the British Commercial Gas Association will again form a prominent central feature in the Section. The Society is co-operating with the other national bodies in the Gas Industry, and is represented on various Committees dealing with important matters. It will also take an active part in the International Congress on Chemical Engineering which is to be held in London in 1935.

At the request of the Board of Trade, said Mr. Bennet, in conclusion, the Society of British Gas Industries is acting as a body to issue Quota Certificates in respect of gas apparatus for importation to France in accordance with the regulations of the French Government.

CHAIRMAN'S ADDRESS

NOTES ON THE VISIT TO CANADA AND U.S.A.

By H. E. Bennet, M.C.

In attempting to prepare a paper on this subject, I am at once confronted with the difficulty of allocating space fairly. That is to say, I am undecided as to the amount of time that should be devoted to descriptions of the country and many wonderful natural phenomena we saw during the visit. If I were to deal only with such matters, to the exclusion of everything else, it would facilitate my work immensely, as I should simply have to copy some pages of Baedeker's "Canada" and other publications of like nature, and soothe my audience gently to sleep by reading them aloud all afternoon. With a view to infusing a little more interest, however, I have felt compelled to abandon this easy way out.

It would obviously be impossible to condense into 25 minutes or so an adequate report of all our travels, considering the 7600 odd miles covered, and the fourteen different cities visited during the five weeks, so I propose to make a very abridged sketch of some of the high spots of the tour, and matters of particular interest. Please, therefore, do not expect a species of diary enumerating all the events in correct chronological order.

First, then, came the outward bound crossing on the "Duchess of York," a ship that will, I think, for a long time hold a place of affection in the hearts of all the mem-

bers of the tour. The " Duchess " was a comfortable ship, and carrying a very agreeable list of cabin passengers. Except for a day of slight fog, and a moderately rough sea one night, the weather was sunny and almost perfect throughout the seven days. The ship has a most delightful sports deck, which includes two deck tennis courts, upon which a lot of time was spent by the majority of our members; it was no hardship to have to wait upon a vacant court, as this presented an excellent opportunity of sitting in the sunshine, and studying the beauty of Nature—both human and marine. Clocks having to be set back one hour each night, we packed 25 hours into every day, and personally I found it not a minute too much.

Having passed through the Belle Isle Strait, north of Newfoundland, some of us were surprised to find it was still 1000 miles to our port of disembarkation, Montreal. The fact that this large port, accommodating ocean-going liners of 20,000 tons, is actually 1000 miles from the open sea, was the first hint, to some of us, that we had not yet realized the immense distances that are involved in American travel. I might add that we were more acutely aware of these by the time we embarked for England again, at Boston.

The President of the Canadian Gas Association, Mr. Hugh McNair, of Winnipeg, met us at Quebec. This sounds a simple enough thing for a President to do, but you will be more appreciative of his courtesy when I tell you he travelled 1500 miles in order to do so.

Hydro-Electric Plants.

While in Montreal we were privileged to see the Beauharnois Hydro-Electric Plant, 40 miles out of the city. One of the world's greatest hydro-electric developments, this is designed for an ultimate capacity of one million H.P. At present 200,000 H.P. is developed, and the Beauharnois power house was quite one of the most impressive pieces of engineering we were shown during the tour. While on the subject of hydro-electric plants, it is worth remembering that many of the Canadian gas undertakings have to meet competition from them on a scale which is more formidable than anything I have yet heard of in this country. For example, Mr. McNair told us that in Winnipeg his electrical competitors make the following tempting offer to housewives presently cooking by gas—viz., to supply a well finished, modern electric cooker free; a cooking rate of 0·9 cent, or less than a halfpenny per unit; and to take over the consumer's old gas cooker, irrespective of condition, for ten dollars, or say £2 2s., in order to break it up.

A Tribute to Generosity.

An outstanding event during the Canadian tour was our reception at Ottawa by the Earl and Countess of Bessborough. On arrival at Government House each member of the party was introduced to the Governor-General, and after we had been entertained to tea his Excellency was good enough to permit our official Film Director, Alderman F. J. West, to take a film of himself and Lady Bessborough on the lawn.

I would emphasize that both Canada and the U.S.A. fully lived up to their reputation for hospitality during our visit; our several hosts seemed almost to vie with each other as to who could do most for us, and our votes of thanks, although hearty and sincere, appeared quite inadequate in the face of such abundance being showered upon us. Consequently, in a short paper like this, it seems ungracious almost to the point of churlishness to hurry through the country, as I am doing, without paying tribute to the kindness and generosity of each city visited. But the above omnibus acknowledgment will have to serve; it is employed only by reason of shortage of space—not of memory.

After having conferred at Ottawa, stayed at the Royal York, Toronto—the largest hotel in the British Empire—marvelled at the natural gas drilling operations near Hamilton, visited the International Nickel Company's plant at Port Colborne, where we saw nickel being poured at 2600° F., we arrived in darkness at Niagara, where we found the most beautiful natural sight of the whole tour. The Niagara River flows at an average rate of over 200,000 c.ft. per second, and the Falls, floodlighted by multi-coloured searchlights, presented a spectacle too beautiful for any such amateurish pen as mine to describe.

We had now to take our departure from Canada, most reluctantly. There is no doubt that Canada is facing a good deal of adversity, and has many severe difficulties to overcome; but there must be several in this room who are as familiar as I am with those two sinister ridges on the old Western Front, Vimy and Passchendaele. When one remembers the endurance, grit, and dash of the Canadian troops who were the ultimate conquerors of both those " severe difficulties," one can have little fear as to the future of the Dominion. That old war-time race still lives, notwithstanding the appalling casualties they suffered, and it is with every confidence I predict that, whatever difficulties may face her, Canada will always win through.

Over the Border.

The first point of contact we made with the U.S.A. was Detroit, at which city we arrived for a stay of only three and a half hours, *en route* to Chicago. Detroit was not dismayed at the problem of how to show us its sights, and the Ford Works, in a matter of three and a half hours; Detroit was made of sterner stuff, and proceeded forthwith to " give us a show."

We were bundled into a small fleet of the fastest motor 'buses I have ever seen, and, escorted by three American " Speed Cops " on motor-cycles, set out on a " super sports model " tour of the city. Until the 'buses, and the policemen, got warmed up, we merely sailed through the crowded thoroughfares at 35-40 m.p.h., but once we got properly into our stride there was no holding us. With syrens and headlamps in full use, the " Speed Cops " tore through the streets, making the night hideous, and flagging all other traffic out of the way. The street crossings are all controlled by the usual red and green traffic lights, but on this occasion the police deposed the lights, and took command; the very sight of a red crossing light inflamed them almost to acts of violence, and while one sat astride his machine

THE CHAIRMAN.

Mr. Harold E. Bennet.

Mr. Harold E. Bennet, the London Managing-Director of Messrs. Alder & Mackay, Ltd., was educated in Edinburgh, and entered the firm's works as an apprentice in 1913. During the war he served on the Western Front with the Cameron Highlanders for almost three years, and was awarded the Military Cross during the German offensive. Following the death of his father, Mr. J. H. Bennet, he was elected to the Board of Messrs. Alder & Mackay, Ltd., in 1919, and was appointed London Managing-Director three years later.

with both arms outstretched, and with his syren screeching continuously, the other two escorted us across, against the lights, at anything from 40 m.p.h. upwards.

Without a single casualty, however, we arrived at the Ford works, and had an all too rapid walk round the coke-oven part of it. The sight of a boiler house staffed by men in white flannels, and clean ones too, was a remarkable one, and it was no less remarkable that one could walk all round this plant, using the hand-rails on the stairs, &c., and not have a speck of dirt on one's hands at the end of the visit.

From Detroit we proceeded by night to Chicago, the fourth largest city in the world, where we were housed in the Stevens Hotel, which claims to be the largest hotel in the world. With 3000 bedrooms, and a record of having slept 5400 people in one night under its roof, this claim is

probably well founded, although contested by one of the New York hotels.

Meters.

I feel it probable that I may be criticized for the absence of technical information in this paper—particularly since I have the honour of addressing a number of very technical people. My excuse, in that event, would be that almost every technical development we saw would warrant a paper to itself, and that it would therefore be sheer presumption on my part to try to condense the outstanding features of all into an address on generalities such as this. I may, however, be pardoned, in view of my occupation, if I betray more than an academic interest in the gas meter position in America, and mention a few of the more striking aspects of it, as seen by a meter manufacturer.

For example, it seems odd to find that in Chicago, with 870,400 meters in use, there are no prepayment meters at all. This, however, is not peculiar to Chicago; no slot meters are to be found in Toronto, Brooklyn (N.Y.), and most of the other cities visited. In this connection, I should perhaps mention that monthly accounts are general in America and Canada. The bag type of diaphragm, as opposed to the disc type, is still in general use, and highly regarded by the Gas Industry over there. Semi-chrome tannage is growing in popularity, but is not used by any means universally; while the most popular case size of meter is undoubtedly the 5-lt., which is rated at 150 c.ft. per hour. Periodical reverification of meters is general. In Canada, no meter may remain *in situ* more than six years, while in the U.S.A. each State has its own legislation governing this matter; some prescribe seven, and some eight years, as the legal limit.

These laws possibly tend to colour the views of both meter makers and gas undertakings on the life to be expected from a meter, and may have some bearing on the fact that ordinary lamb skins, instead of Persian sheep skins, are used for meter diaphragms throughout America, apparently to the satisfaction of all concerned. At the same time, I must pay a high tribute to the ingenuity shown, and the highly developed methods of mass production in use, in such meter factories as we visited; their scientific use of machinery, and its outstanding efficiency, were obvious at a glance.

In Chicago—where they have 80,000 meters on the district standing idle, out of their total of 870,400, on account of the depression—it was interesting to learn that most of the gas consumed comes from the natural gas fields of Texas. It is pumped, at pressures exceeding 200 lbs. to the inch, along 980 miles of 26-in. main to Chicago and into the largest gasholder in the world, a waterless holder of 20 million c.ft. capacity. The top of the tower of this holder is 486 ft. from the ground.

Very Tall.

There was very little free time during our stay in Chicago, as the American Gas Association was packing several meetings into each day of its Convention, and a very busy three days were spent by our party in consequence. During a spare hour, however, I visited that famous skyscraper, the Wrigley Building, on a day of perfect visibility, and could see St. Joseph, 60 miles away, across Lake Michigan, quite clearly with the naked eye.

The most impressive skyscraper visit, of course, was that to the Empire State Building in New York, from the top of which a most comprehensive view of Manhattan Island is obtained. The Empire State Building is the highest structure in the world, considerably higher than even the Eiffel Tower in Paris. When visiting the roof, the express elevator takes one in a single non-stop rush of one minute to the 80th floor, where there is a change for the 102nd floor. The building is 1250 ft. high, and sways 6 ft. at the top, when high winds are blowing.

I was told there of the case of a gentleman who was bent on suicide, but wanted some notoriety to be attached to it. Eschewing gas-oven practice, therefore, he mounted the Empire State, and dramatically cast himself over the parapet at the top. Unfortunately, he overlooked the fact that the building is "stepped in" several times in its construction—narrowing inwards every so many feet upwards—so that, instead of falling 1000 ft. on to Fifth Avenue, he only fell a few feet on to the next ledge down; they were therefore able to mend him, and use him again.

The N.R.A.

The "new deal," as the work of the National Recovery Administration is termed, naturally excited our curiosity, as visitors to a country undertaking so gigantic an experiment. At a superficial glance it seems to be helping to restore confidence and prosperity to America, and their employment figures are undoubtedly responding most favourably to the new national motto of "We do our part."

Inevitably, there is a sharp division of opinion as to the ultimate result, and one man, President of a large firm of gas plant manufacturers, summed up in few words the expressions of many, when he said to me: "Can it do us any good? Well, we pray devoutly that a method we know must fail, will succeed, but did you ever see a man lift himself up by his own boot-strings?" Another, of more optimistic outlook, said: "When a company has been singing the blues, and making red-ink profits for three years, as we have been, it is kind of glad to give the 'new deal' a fair break; after all, it is trying something instead of doing nothing."

Athletics.

Our last city was Boston (Mass.), and it was rather a surprise to find that this historic New England port now has a population of almost two millions. The scene of the famous Boston Tea Party in 1773, and the Battle of Bunker Hill in 1775, Boston proved itself one of the most interesting cities a British party could have visited. Since it is the home of that famous American University, Harvard, I may, perhaps, touch lightly upon the matter of athletic sports, as presented to us—all too briefly—during the tour.

We were greatly indebted to our hosts, both in New York and in Boston, for contriving that we should see samples of Baseball and American Football during our stay. The "Ball Game" in New York was a World Series match of great importance, Giants v. Senators, and was comparable with a Cup Tie Final in England; it was a quite definite "high spot" of the visit, and greatly appreciated by the members who attended.

The football match, during our time in Boston, was between Harvard and Bates, in which the Harvard men were on top all along; and although their crushing superiority robbed the match of any great excitement, it was a most entertaining afternoon—especially to those of us who had played Rugby in our earlier days. The extraordinary sight afforded by the players "going into a huddle" after almost every whistle, was particularly intriguing. Apparently the captain of the team, during this species of confidential board-meeting, when all heads are bent together, and towards the ground, issues his instructions in a whisper as to the next operation to be undertaken. Then the "huddle" breaks up, and the battle proceeds according to plan.

Although sporting events of types reported above were thoroughly enjoyed during the visit, I should be most dismayed if my remarks were taken to mean that the whole tour was in the nature of a joy-ride; on the contrary, it was a very serious and very valuable piece of liaison work between members of the Industry of both hemispheres, and I am confident that the increased friendship and better understanding which it initiated will become more evident and more appreciated as time goes on.

I should also like to pay a tribute to the untiring work of both the President, Mr. Tarratt, and the Secretary, Mr. Alexander, of the Institution of Gas Engineers. It fell upon Mr. Tarratt to have to speak at every place visited, either to deliver an address or to propose someone's health, or to return thanks for the extensive hospitality shown; the continuous strain must have been severe, although it is only fair to add that not a trace of it was ever revealed. The excellent organization work of Mr. Alexander was responsible for all the arrangements working out smoothly, and accurately to time; with a flair for getting things done, and done correctly, no less attractive than his everlasting good humour, I marvel that upon our arrival at Liverpool he did not emulate his famous ancestor and weep for want of further worlds to conquer.

Concluding with the homeward bound voyage, we embarked at Boston on the m.v. "Georgic," a 27,000 ton Diesel-engined ship of very modern construction—in fact, of 1932 vintage. She was remarkably steady in the heavy following seas experienced during most of the crossing, and her slow, amiable roll inconvenienced nobody. On a visit to the engine room, we saw her 20,000-H.P. Diesel engines at work, driving two beautifully polished 19-in. diameter propeller shafts. The bearings of these shafts are fitted with tell-tale apparatus, so that the first signs of wear in any one of them is at once recorded in the chart room. The "Georgic" carried 1600 tons of fuel oil, and used 84 tons per day; as an interesting comparison, the "Duchess of York" on the outward journey used 100 tons per day.

On arrival at Liverpool, on Oct. 16, the party dispersed, some to Scotland, some to Ireland, and the majority to various parts of England; and I feel safe in saying that the

memory of the 1933 visit to Canada and the U.S.A. will always rank among the very happiest in the minds of every participant.

Mr. F. B. Richards (Woodall-Duckham Companies) endorsed all that the Chairman had told them about the trip. He realized that the tour from the technical point of view was rather hurried, but he considered that its value was incontestable, and it should be regarded as a big step in the way of promoting international co-operation. They as an Industry had done their bit to promote a proper understanding between these English-speaking races, which was so important. He paid tribute to Mr. Tarratt for the way in which he led the delegation. They could not have had a better leader nor a more popular one, and the fact that the party came back to England all good friends and having made so many more over there was high testimony to the way he looked after them.

Mr. F. J. West said how greatly he appreciated Mr. Bennet's racy description of one of the most interesting tours he (the speaker) had ever made. The outstanding feature of the tour, in his opinion, was the wonderfully cordial reception given by their hosts in both countries. Their appreciation of what they considered a great honour paid to them by the Gas Industry of Great Britain was evident on many occasions. Their arrangements for the visitors' comfort and their sincere desire to place at their disposal every possible means of obtaining information in regard to gas practice in Canada and the United States were most impressive. One could not over-estimate the value of all the information gained on a tour such as the one they had just completed.

Sales Methods in America.

The Gas Industry, continued Mr. West, had given them some very useful information, probably that of the greatest value to most of them being their selling and service organizations. The Americans gave them many new ideas in regard to boosting the use of gas and selling it to the consumer. He also referred to the valuable interchange of opinion and the broadening of their outlook generally which the tour afforded. There was one paragraph in Mr. Bennet's address which he particularly appreciated. Having touched upon the lighter side of the tour, he emphasized that it was by no means a joy-ride. It was a mistake to argue that there was not a great deal of advantage to be gained by taking part, because one could always read all about it in the Technical Press. If there were no meetings there would be no Technical Press. To suggest that it was a joy-ride would be a misconception; it was one of the most strenuous journeys he had ever undertaken. He would say, without in any way suggesting that the delegation was tremendously important, that they upheld the prestige of the Gas Industry in this country, and it was greatly appreciated by the members of the Industry on the other side.

Finally, he said, without wishing to disparage efforts of their political leaders in regard to their Disarmament Conferences and Empire Conferences, better assistance could be given by carrying out such visits as they had just made. One of the most important parts of liaison work lay in understanding each other's points of view. This tour had brought about a better understanding between business people in this country and in the United States and Canada.

Mr. F. P. Tarratt (President of the Institution of Gas Engineers) agreed that they had a most strenuous time. They were a very happy team, and speech-making was a feature of the visit. Both Americans and Canadians were really wonderful speakers. They had a particularly fine speech from the Premier at Ottawa; he was a charming man and kept them spellbound. Mr. Hugh McNair made an excellent President, and under his guidance they got through the business in a very expeditious manner. Mr. Arthur Hewitt always had something new to say. One of the prominent men they met was Mr. G. B. Cortelyou, President of the Consolidated Gas Company of New York, who was one of the most charming men he had ever had the privilege of meeting. He also referred to seeing again Mr. Clifford E. Paige, whose strength of character had made an impression on them when he visited this country for the Institution of Gas Engineers' meeting in 1931.

Finally, Mr. Tarratt paid tribute to the splendid organization of the whole tour, which took a great load off the individual members' shoulders.

Dr. E. W. Smith proposed a hearty vote of thanks to Mr. Bennet for his most interesting address. The Council and members of the Society who were not fortunate enough to go with them on this visit were very proud of the way they had been represented on the trip. They felt that they had made no mistake when they asked Mr. Bennet to summarize his experiences in America. It had been a most acceptable address.

Mr. E. J. Fox, in seconding the vote, said he was sure they all felt two things—namely, that their mission was in very safe hands in Mr. Bennet and Mr. Tarratt, and that no two individuals could have been chosen to maintain their prestige better than these gentlemen.

British Empire Trades Index.

The 1933-34 edition of the *British Empire Trades Index* has just been published by Business Dictionaries, Ltd., of Johnson's Court, Fleet Street, E.C. 4, and 25,000 copies of this "Marketing Guide" are now being dispatched to principal business houses and British and Foreign Government Departments throughout the world, with a view to linking-up the great buying houses with leading British Empire makers, producers, and distributors.

The function of the *British Empire Trades Index* is to facilitate and expedite the interchange of commerce not only between the various units within the Empire, but with buyers and sellers in other countries who desire to trade with the British Commonwealth of Nations. The *British Empire Trades Index* gives the names and addresses and trade or profession of Empire firms whose business it is to buy and to sell or to provide transport facilities, insurance, financial, or other necessary services in connection with trade and commerce.

Compilation and revision of the volume involve great labour and expense, but it is hoped the result achieved may merit the appreciation of buyers, sellers, manufacturers, producers, and distributors throughout the world, who are regularly supplied with a copy of this valuable work.

The volume contains three main divisions:

In Section I. the trading concerns are arranged alphabetically under their applicable trade headings—those located in Great Britain and Ireland, followed by those in the various Dominions overseas. Commodities which are produced in Great Britain, Canada, Australia, New Zealand, Union of South Africa, and India come under one trade heading, thus showing the resources of the whole Empire in any particular line of goods. The whole of the British Empire is treated as one unit, so that the list is equally useful to Great Britain, the Dominions overseas, and India.

Section II. is an alphabetical index by name of all firms appearing under the respective trade headings in Section I.

Section III. is devoted to trade marks and brands which the publishers have collected and hope to increase year by year as the information comes to hand. This section is of very great value to firms who protect their goods by means of trade marks and brands.

A few copies of this 576-page volume are available to business firms, price 2s. 6d. to cover packing and postage.

BOOK REVIEW

COKE OVEN MANAGERS' YEAR BOOK.

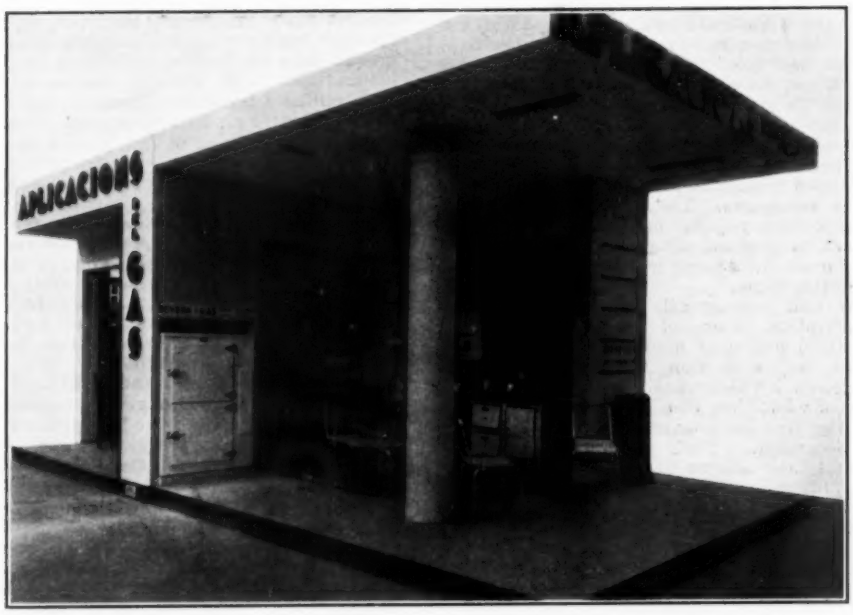
The Coke Oven Managers' Year Book, 1933, published by Benn Bros., Ltd., for private circulation only, is now firmly established as a record of practical work and information, valuable to all who are in any way interested in coking practice.

In this, as in previous issues, the usefulness of the book is preserved by the inclusion of only such matter as is considered likely to be of service. Included in the contents is useful information on the rules and membership of the Coke Oven Managers' Association, with lists of officials, past-presidents, and members. Considerable progress has been made in the compilation of the list of coke oven plants abroad. Several new sources of information have been obtained, and while the completeness and accuracy of the list in every particular is not vouched for, its reliability is considerably improved. In particular, the lists for France, Poland, and all parts of the British Empire may be regarded as absolutely correct.

The remainder of the volume is devoted to the transactions of various sections of the Association, full reports, with photographs and diagrams, being given of the various papers read. Altogether this is a very useful book, summarizing in a comprehensive manner another year's activities of our sister industry; and users of the book should find it fully as valuable as its predecessors.

XUM

Gas Production in Barcelona



A CORNER OF THE CATALANA GAS AND ELECTRICITY COMPANY'S DISPLAY AT THE RECENT INDUSTRIAL FAIR IN BARCELONA.

It is satisfactory to find that, although the Sociedad Catalana de Gas y Electricidad is, as its title implies, associated with both gas and electricity supply in the city of Barcelona, the gas section of the concern continues to make steady progress. As a matter of fact, it is the largest of the total of fifty-one gas undertakings in Spain, and according to some figures which have lately come to hand the production during 1932 reached a total of 2219 million c.ft., an advance of 78,735,000 c.ft., or above 3·7%, as compared with that of the preceding twelve months.

A good deal of public street lighting is undertaken by the Company, the number of lamps having been increased

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during the twelve months under review from 6560 to 6572, while during the same period the number of consumers increased to the extent of 4·15%—*i.e.*, from 139,717 to 145,458, these figures also representing the number of installed meters of which, at the end of 1932, 70,098 were of the ordinary type, while 75,360, or over 50%, of the total were of the prepayment pattern.

Altogether the Catalana Company possesses no fewer than sixteen gasholders with an aggregate storage capacity of 630,600 c.ft.

Much attention has been devoted by the Company in recent years to the popularizing of the use of gas for cooking and heating, and that the efforts which have been put forward in this direction have met with success is indicated by the fact that during 1932 the number of gas cookers installed in the Barcelona area increased from 7500 to 10,227, an increase of no less than 36%.

As an indication of the Catalana Company's enterprise in the encouragement of the domestic use of gas, we are able to reproduce a photograph of its stand at the Industrial Fair held in Barcelona during the past summer. One side of the stand was devoted to a display of large photographs of various gas-using installations, while the other side was divided into two sections, one of which—that seen in the picture—was set out as a gas-equipped kitchen for a family, the display therein, in addition to a cooking range, including a constant-supply hot water heater, radiator, and a gas-operated refrigerator. The other section was devoted to a very neatly and attractively arranged gas-equipped kitchen for a newly-married couple.

NEW SHOWROOM PREMISES AT MARGATE

Exterior of Isle of Thanet Company's new showroom premises, illuminated at night by Sugg's "Rochester" lamps, automatically controlled.

The Isle of Thanet Gas Company have recently converted a school adjoining the works into a showroom, including a spacious demonstration room where cookery lectures are given.

The main showroom measures some 75 ft. in length by 20 ft. wide, giving excellent display accommodation. There is a counter, with superintendent's office and private consulting room behind. An up-to-date hot water section shows examples of modern appliances, all connected up and in working order. The lighting is effected by means of 5-light "Kingsway" lamps.

Entered from the main showroom, the demonstration room, 53 ft. by 22 ft., is capable of seating 150 people, and has a platform at one end, complete with cookers, a meter with a large dial, and sink and hot water equipment. The lighting of this room is effected by means of "Bon Marché" lamps. The Company make a practice of supplying tea to those attending each lecture, and the premises are equipped with suitable kitchen and ample storeroom to meet consumers' needs.

ENTRANCE HALL OF NEW PREMISES AT MARGATE.

A New Installation of Glover-West Verticals at Forli, Italy*

By C. Jori, General Manager of the Municipal Gas and Water Services of Forli.

The Administration of the Forli Gas Undertaking, having decided in 1931 to extend and modernize its installation for the production of gas, charged the writer with the task of studying the re-organization of the works and the distribution services.

In 1931 the output of the works was 56½ million c.ft., with a maximum per day of 198,000 c.ft. Gas was distributed with a calorific value of 465 B.Th.U. per c.ft. It was decided to extend the works for a maximum production of 318,000 c.ft. per day, with one-third reserve of carbonizing plant, and it was proposed to improve the distribution system by carrying out several alterations in the mains, and by constructing a high-pressure feeder main for the purpose of reinforcing the system at three points, distant respectively 700, 1700, and 3100 metres from the works.

A new telescopic gasholder of 106,000 c.ft. capacity has been constructed, and one of the existing holders has been converted to the telescopic type, increasing its capacity to 70,600 c.ft. The storage capacity has thus been increased to 212,000 c.ft. A new line of purification plant has been installed, and, further, all the buildings have been reorganized, and a laboratory installed for the complete control of manufacture.

The administration brought its greatest care and attention to bear upon the choice and construction of the retort bench. Hitherto, gas had been produced in settings of small horizontals hand-charged by scoop. The new installation was to be of the most modern type, capable of dealing with coals of different varieties and of adjustment for the production of gas or coke according to requirements. The problem was studied at length. Several installations were visited, and the advantages and disadvantages of each were noted. After a very careful examination, the choice was fixed upon the Glover-West system of continuous carbonization in vertical retorts, of which the Societe Anonima Forni ed Impianti Industriali holds the rights of construction in Italy.

We can say at once that the installation, which has already been in operation for eight months, has fully responded to our expectations, and that it can be operated and adjusted to requirements with the greatest facility.

The installation is built in four settings, each of two retorts of a daily capacity of from 2·7 to 3·4 tonnes. Each setting is separated from its neighbour by a wall of sufficient thickness to permit of the re-setting of any one of them with the neighbouring setting in operation. Each setting is heated from its own producer, and is provided with equipment for heating by a mixture of producer gas and by coal gas.

The coal supply is effected by a skip hoist with two points of stoppage and a bunker placed above the retorts. For the producer a separate bunker is provided.

Special Characteristics.

The installation presents, besides some small peculiarities of construction, the following special characteristics:

(*a*) A complete recovery of heat from the waste gases in a high-pressure boiler supplying, by means of a turbine, the motive power for the requirements of the installation, the exhaust steam from the turbine being utilized for "steaming" the retorts.

(*b*) The special insulation of the walls of the retort bench, rendered necessary by the fact that, normally, only two settings are in operation.

(*c*) Gas collecting mains with tar circulation.

It is interesting to examine each of these characteristics in greater detail.

The boiler is capable of recovering the heat contained in the waste gases from four settings in normal operation. This boiler is of the vertical water-tube type, with exterior circulation. The products of combustion enter the boiler at the upper end of a nest of tubes and leave at the base. The water passes through the nest of tubes from the bottom to the top and returns to the base by the exterior circulation tube. A counter-current is thus established between the products of combustion outside the nest of tubes and the water in the interior of the tubes themselves, giving an excellent steam production from the boiler.

The boiler is provided with a superheater, sectionable by means of dampers of refractory materials. This arrangement permits of the regulation at will of the temperature of superheat of the steam. The steam pressure within the boiler is 13 kgs. per sq. cm. (185 lbs. per sq. in.) and the steam is superheated to 350° C. The steam is thus eminently suitable for the production of power.

A portion of the steam generated in the waste-heat boiler is sent to a turbine which actuates a line shaft, from which is driven the fan for the draught through the settings and the driving gear for the coke extractors of the retort bench. The surplus steam is available for works purposes, such as the manufacture of sulphate of ammonia, heating of offices, baths, &c.

The turbine operates at high pressure. The exhaust steam proceeds to the retorts for the steaming process. This steam leaves the turbine at a pressure of 1½ kg. per sq. cm. (21 lbs. per sq. in.) and a temperature of 220° C., and is thus in excellent condition for the "steaming" of the retorts.

A portion of the exhaust steam is also employed under the grates of the producers to facilitate the disintegration of the clinker, assuring the production of a good quality fuel gas, and permitting (a very important point) the use in the producers of all the breeze in the coke produced in the installation.

The fact that the coke extractors and the induced draught of the settings are actuated by steam produced on the retort bench itself, constitutes a very appreciable advantage which showed itself in decisive fashion when, during the winter of 1932-33, following exceptional falls of snow, the supply of electricity to the works was much disturbed, and several prolonged stoppages of current took place. The retort building, being quite autonomous, was able to maintain its operation with perfect regularity.

Retort Bench.

The retort bench is covered with special insulating material. The walls are constructed in three different materials; in the interior there is a layer of silica bricks; the intermediate layer is constructed in bricks which are porous in texture, with excellent refractory qualities but having a coefficient of conduction much lower than that of ordinary refractory materials; and the exterior of the walls is composed of insulating bricks proper. With this arrangement the loss of heat from the settings by radiation is reduced to the minimum; one can easily place one's hand on the outside of the wall while the temperature of the interior is of the order of 1300° C. The advantage of such a construction is clearly shown by a reduced fuel consumption.

The gas collecting mains of the settings are of the dry type, each composed of a simple tube of rectangular section rounded at the bottom, with neither division, hydraulic seal, nor any other accessories.

These mains are provided with a flush-out valve at the bottom, by which escapes, continuously, the gas produced in the retorts and the circulating tar. This tar is introduced ino the mains at the extremity opposite to that of the exit of the gas, in such a manner that it travels the whole length of the mains before leaving with the gas.

The circulation of tar is continuous. It is effected by a vertical piston type pump with ball valves, with an oscillating pump serving as reserve. The cleaning of the mains is reduced to zero because the circulation of tar keeps them perfectly clean.

Circulation of tar through the collecting mains presents the advantage of giving, direct from the continuous vertical retorts, practically dehydrated tar—that is to say, tar containing not more than 1½ to 2% water.

The ammoniacal liquor which is produced by the mixture of the water coming from the mains and that from the washers can easily reach a concentration of 2° to 2½° Baumé; it is, therefore, in good condition for distillation in the sulphate plant.

Another point to be noted is that the coal feed hoppers are constructed in electrically welded steel plate and not in cast iron. This construction has the advantage of avoiding cracks due to sudden variations in temperature such as are produced during scurfing.

Several qualities of coal have been carbonized, with satisfactory results. The great flexibility of the system, and its possibilities for adaptation to works of still smaller capacity is to be remarked.

It remains to add that the Societe Anonima Forni ed Impianti Industriali of Milan has carried out the contract with the greatest care, and with a technique which reveals the very greatest competence. The Company has constructed the installation without seeking to economize on equipment, and has produced an installation which, after two months of operation, has given results in excess of those guaranteed.

* From the October issue of *West's Gas*.

LEGAL INTELLIGENCE

"Kleenoff" *v.* "Kleenup"

An Injunction Granted

An action by Bale & Church, Ltd., of St. Mary Hill, E.C., against Sutton, Parsons, & Sutton, who carry on business as Astrah Products, Ltd., at Sutton, Surrey, was commenced in the Chancery Division by Mr. Justice Clauson, on Nov. 10, the plaintiffs claiming damages for alleged infringement of trade mark and passing off.

Mr. Trevor Watson, K.C. (for Bale & Church, Ltd.), explained that the trade mark involved was one registered under Part B of the Register of Marks, and consisted of the word "Kleenoff." That was a jelly-like substance for cleaning gas cookers and was a grease remover. Part B of the register, said Mr. Watson, largely had as its purpose the giving of some statutory title to people who used a mark for a considerable time on the article they supplied, and to facilitate registration in other countries.

Plaintiffs were incorporated in 1911, being successors of a partnership of the same name, and they were gas supply manufacturers. In 1910 the partnership introduced to the market the preparation known as "Kleenoff," which was extremely well known in England and many other parts of the world. It had been extensively advertised, and hundreds of thousands of tins were sold every year.

Registration of plaintiffs' mark had duly appeared in the *Trade Mark Journal* in Part B, Class 47, the user being claimed from August, 1910; and "Kleenoff" was distributed through the usual trade channels. There had been on the market during that time other similar preparations known by fancy names, but, Counsel said, he could call evidence that "Kleenoff" was indicative plainly of the plaintiffs' preparation.

About the beginning of this year, so the plaintiffs alleged—the defendants stated that it was somewhat earlier—there appeared on the market a preparation in tins called "Kleenup." This was sold by defendants. Plaintiffs first knew of its existence from a letter received from a gas company in the West of England. Correspondence ensued, and the defendants adopted the attitude that their preparation was not like the plaintiffs', as plaintiffs' was for use on gas cookers and defendants' was not. But, said Counsel, the point was that plaintiffs contended that "Kleenup" was so similar to "Kleenoff" that it was calculated to deceive and lead to confusion, with the result that passing off could successfully be alleged. They consequently asked for an injunction to restrain infringement and to restrain defendants from selling, offering, or exposing for sale a preparation for removing grease, not being of plaintiffs' manufacture, known under the name of "Kleenup" or any other name calculated to lead purchasers to believe that they were buying plaintiffs' goods. An inquiry as to damages and the usual order for delivering up of existing stocks of goods marked "Kleenup" was also claimed.

Defendants, added Counsel, denied the plaintiff Company's allegations, and also denied that they had infringed, or threatened to infringe, plaintiffs' trade mark. They pleaded that the user of the mark "Kleenup" was not calculated to deceive or lead to the belief that goods so marked were the plaintiffs'.

Mr. Bale, who is a Director of the plaintiff Company, gave evidence supporting Counsel's statement, and, in cross-examination by Mr. Shelley (for defendants), admitted that while his Company's preparation was a jelly-like substance defendants' was in the nature of a paste and was a non-caustic cleaner.

When the hearing was continued on Nov. 13, Mr. Shelley submitted, for the defendants, that there was no evidence against his clients to support the plaintiffs' case that "Kleenup" was calculated to deceive, or was deceiving, the public. The "get-up" was different, plaintiffs' being a round tin and defendants' a flat one. There was, he contended, absolutely different descriptions, and not one piece of evidence of the public having been deceived.

Mr. Justice Clauson, in his judgment, said "Kleenup" was at first sold for the hands, and later it was found to be useful for stoves. He did not hesitate to say that what defendants had done was to infringe the plaintiffs' trade mark. It was perfectly true that "Kleenup" was not an exact reproduction of "Kleenoff," but, notwithstanding that, he was bound to hold that the trade mark used by defendants bore such a close resemblance to plaintiffs' that the ordinary careful purchaser buying the product might be deceived and misled into thinking it was plaintiffs'. Therefore, he was satisfied that defendants had infringed plaintiffs' mark, and he would grant plaintiffs the injunction they asked with an inquiry as to damages.

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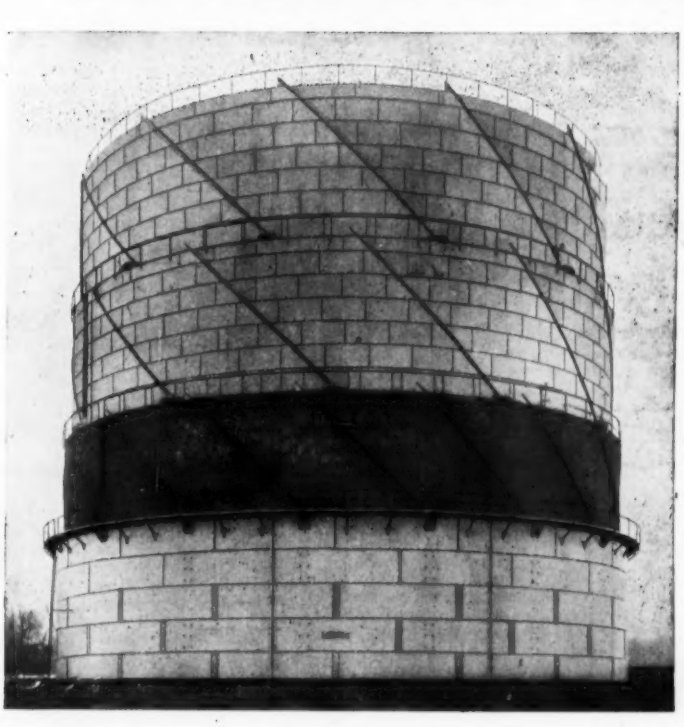

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GAS MARKETS & MANUFACTURES

Stock Market Report.

[For Stock and Share List, see later page.]

The new Account began last week with a dull tone, but confidence was restored by the latest revenue figures coupled with the Chancellor's optimistic statement regarding the outcome of the current financial year. Leading industrial shares became active, and the steady buying of British Government stocks continued. Towards the close, however, the erratic movements in the dollar were a disturbing influence, and although there were a few bright features, such as Home Rails and Rubbers, the general tone became irregular.

The Gas Market continued firm and unperturbed by any outside influences. Business was done in most cases at top prices and several upward movements occurred. Oriental ordinary advanced a further 5 points to 132½, making 16 points' increase during the past fortnight. Brighton 6% preference rose 4 to 141½; Bombay £1 shares gained 1s. to 27s.; and South Suburban ordinary advanced a further 1 to 133½. Gas Light units were marked down 3d. to 27s. 9d.

At the time of writing the supplies of ordinary and debenture stocks available are with few exceptions still small, and, omitting the issues of the Metropolitan Companies which are usually readily obtainable, the following lists may be of interest:

ORDINARY STOCKS.

Amount Offered.	—	Dividend 1932.	Price.	Gross Yield.
£		%		£ s. d.
951	British	7½	163	4 12 0
2,500	European	6*	135	5 18 6
250	Liverpool	6	132	4 10 10
100	Mid-Kent £10 shares	4½	10	4 10 0
1,000	South Shields	8½	177½	4 15 9
1,523	Wandsworth	7	158	4 8 7
100	Wakefield 5% max.	5	103	4 17 1

* Free of tax.

DEBENTURE STOCKS.

Amount Offered.	—	Price.	Gross Yield.
£			£ s. d.
113	Liverpool 4%	102½	3 18 0
150	Long Eaton 5%	117	4 5 6
100	Maidstone 3%	77	3 18 0
12,820	Mid-Southern Utility 4%	105*	3 16 2
115	Oxford 5%	120	4 3 4
460	Plymouth 5%	112	4 2 0
100	Reading 4%	103½	3 17 3
200	Wellington (Salop) 5%	117	4 5 6

* Free of stamp duty. Two months' interest payable Jan. 1.

Current Sales of Gas Products.

The London Market for Tar Products.

LONDON, *Nov.* 13.

The prices of tar products throughout the week have been steady, with further advances taking place in white spirits. Current values are as under:

Pitch is about 77s. 6d. per ton f.o.b.

Creosote, 3d. to 3¼d. per gallon.

Refined tar, 4d. to 4¼d. per gallon in bulk at makers' works.

Pure toluole, about 3s. 3d.; pure benzole, 1s. 10d. to 1s. 11d.; 95/160 solvent naphtha, 1s. 8d. to 1s. 9d.; and 90/140 pyridine bases, about 5s.—all per gallon naked at makers' works.

Tar Products in the Provinces.

Nov. 13.

The average prices of gas-works products during the week were: Gas-works tar, 29s. to 34s. Pitch—East Coast, 70s. to 72s. 6d. f.o.b. West Coast—Manchester, Liverpool, Clyde, 70s. to 72s. 6d.* Toluole, naked, North, 2s. 5d. to 2s. 6d. Coal-tar crude naphtha, in bulk, North, 6¼d. to 6¾d. Solvent naphtha, naked, North, 1s. 7¼d. to 1s. 7½d. Heavy naphtha, North, 10½d. to 11d. Creosote, *ex* works, in bulk, North, liquid and salty, 2d. to 2½d.; low gravity, 2d.; Scotland, 2d. to 2½d. Heavy oils, in bulk, North, 4d. to 4¼d. Carbolic acid, 60's, 2s. 5d. to 2s. 6d. Naphthalene, £9 10s. to £10 10s. Salts, 55s. to 75s., bags included. Anthracene, "A" quality, 2½d. to 3d. per minimum 40%, purely nominal; "B" quality, unsalable.

* All prices for pitch are now quoted on the basis of f.o.b. In order to arrive at the f.a.s. value at any port it will be necessary to deduct the loading costs and the tolls whatever they may be.

Tar Products in Scotland.

GLASGOW, *Nov.* 11.

Quotations remain steady in this area, although there is not a great deal of new business being placed.

Crude gas-works tar.—The actual value is 40s. to 42s. per ton *ex* works.

Pitch.—With little business in view prices are irregular. Value f.o.b. Glasgow is called 67s. 6d. to 70s. per ton, while home quotations are now 65s. to 70s. per ton *ex* works.

Refined tar to Ministry of Transport Specification is unchanged at 3¼d. to 3⅝d. per gallon f.o.r. in buyers' packages.

Creosote oil.—More business is offering, but distillers are short. Values are stronger. B.E.S.A. Specification is 3⅛d. to 3⅜d. per gallon; low gravity, 3⅛d to 3⅜d. per gallon; and neutral oil, 3¼d. to 3½d. per gallon; all in bulk *ex* works.

Cresylic acid.—Some large bookings have taken place during the week. Pale, 97/99%, is 11¼d. to 1s. 0¼d. per gallon; dark, 97/99%, 9½d. to 10½d. per gallon; and pale, 99/100%, 1s. 3d. to 1s. 4d. per gallon—all f.o.r. in buyers' packages.

Crude naphtha.—To-day's price is 4½d. to 5d. per gallon *ex* works in bulk, according to quality and quantity.

Solvent naphtha.—90/160 grade is higher at 1s. 6d. to 1s. 7d. per gallon, but 90/190 heavy naphtha is unchanged at 1s. per gallon.

Motor benzole.— Quotations are firm at 1s. 7d. per gallon *ex* works.

Pyridines.—90/160 grade is 3s. 3d. to 3s. 6d. per gallon, and 90/140 grade 3s. 6d. to 3s. 9d. per gallon.

Benzole Prices.

These are considered to be the market prices for benzole at the present time:

	s. d.		s. d.	
Crude benzole	0 10	to	0 10¼	per gallon at works
Motor "	1 5	"	1 5½	" " "
Pure "	1 8½	"	1 9	" " "

New Capital Issues.

Bideford Gas and Coke Company, Ltd.—As will be seen from our advertisement columns, Messrs. A. & W. Richards are offering for sale by tender 1200 £10 5% cumulative preference shares in this Company. The minimum price of issue is £11 per share, and the yield at this price is £4 10s. 11d.%. Tenders must be received not later than 11 a.m. on Tuesday, Nov. 21.

Ascot District Gas and Electricity Company.—The tenders for the 3640 £10 5% preference shares, which were offered on behalf of the Directors of this Company, were opened on Nov. 8. The issue was more than four times covered (the tenders sent in totalling 14,729 shares) at prices ranging from £12 10s. down to the minimum of £11 per share. The lowest price accepted was £11 11s. 6d. per share, and the average price obtained £11 16s. 9d. per share.

Contracts Advertised To-Day.

Meters.

Stretford and District Gas Board. [p. 538.]

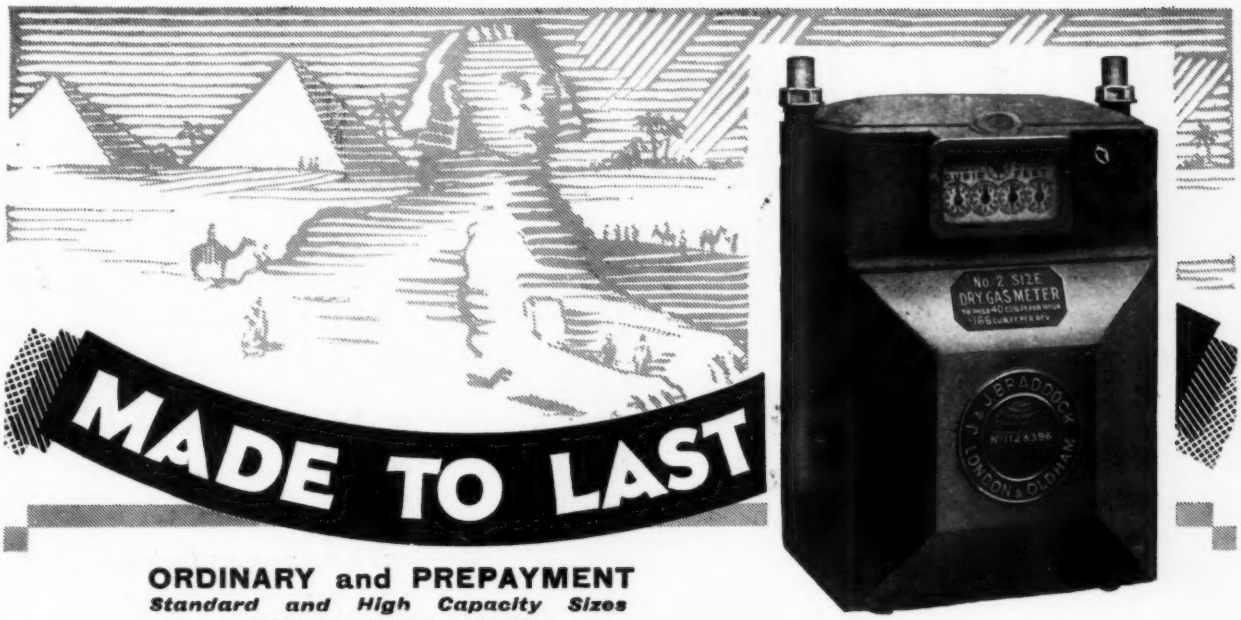
Trade Notes.

A Change of Title.

The Ruud Manufacturing Company, Ltd., South Africa House, Wembley, advise us that, as and from Nov. 1, 1933, the name of the Company has been changed to the National Gas Water Heater Company, Ltd. The Management of the Company is in no way altered.

Automatic C.W.G. Plant.

The St. Andrews Gas Company have placed contracts with Messrs. Humphreys & Glasgow, Ltd., for their latest type automatically-operated carburetted water gas plant and for reconstructing their existing carburetted water gas plant for automatic control. A similar order has also been placed with the above firm by the Banff and Macduff District Gas Company for reconstructing their water gas plant for automatic control.



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Standard and High Capacity Sizes
COVERED BY STANDARD GUARANTEE

Any kind or make of Dry Meters or Wet Meters repaired

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GLOBE METER WORKS – OLDHAM
TELEGRAMS: "BRADDOCK, OLDHAM." 'PHONE No.: MAIN (OLDHAM) 3815/6
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Only the finest materials are used in the construction of our meters

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Was *supplied* in 1901

And is *still* in use

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2645, WATFORD

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(BRANCH OF METERS LTD.)

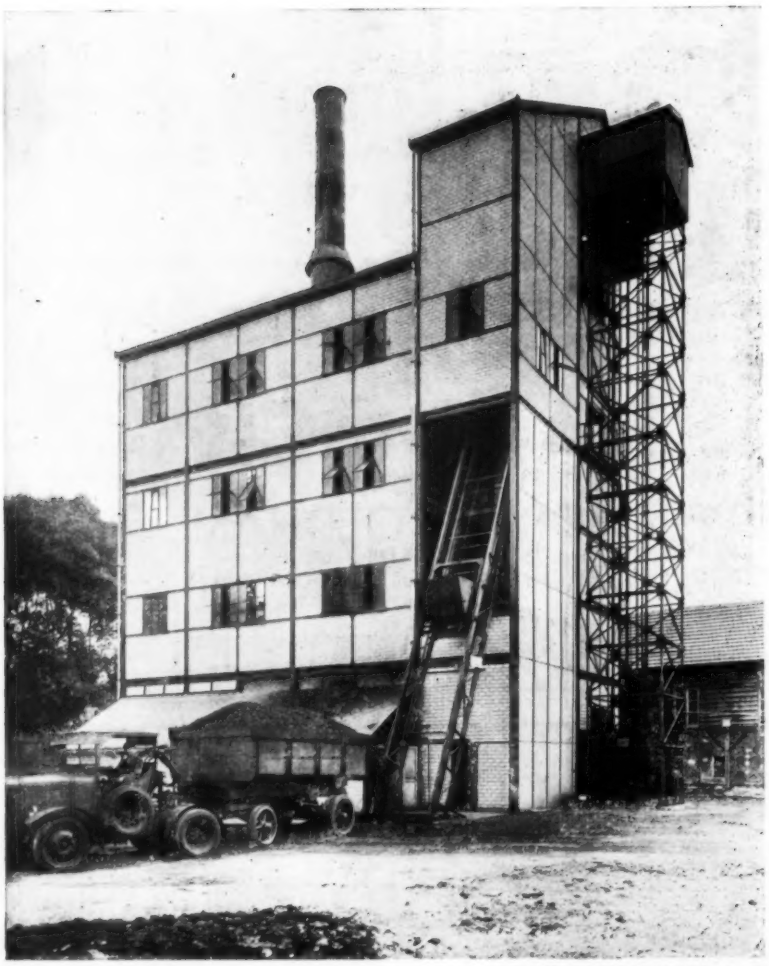
NELSON METER WORKS
MANCHESTER 10

DERBY ROAD
WATFORD

RADFORD METER WORKS
NOTTINGHAM

500 *million*

CUBIC FEET OF GAS PER DAY



[*Photo by F. HARAND, Paris.*

is the estimated total capacity of Glover-West continuous vertical retort installations in service or now in course of construction in this country and throughout the world.

The illustration shows the Glover-West plant recently installed at the works of the Beauvais Gas Co., France. The plant comprises 12 retorts with a daily capacity of 530,000 cu. feet.

GLOVER-WEST VERTICAL RETORTS

•

THE "WEST" AUTOMATICALLY LUBRICATED LIP-BUCKET CONVEYOR

•

THE "CALVERT" COKE CUTTER

•

THE "WEST" COKE GRADER

•

WAGON TIPPERS
SKIP HOISTS
BELT CONVEYORS
COAL BREAKERS
TELPHER PLANTS

The Glover-West system has now been adopted by 125 undertakings in Great Britain and Ireland, 20 in the British Dominions, and 55 in foreign countries. Nearly 350 plants, comprising 9,700 retorts, have been installed.

Glover-West vertical retorts and West handling plant are designed, manufactured and erected by

WEST'S GAS IMPROVEMENT CO. LTD.

MILES PLATTING, MANCHESTER, 10

Telephone: Collyhurst 2961 (4 lines)

Telegrams: "Stoker" Manchester

LONDON OFFICE: REGENT HOUSE, KINGSWAY, W.C.2 . . . . *'Phone:* Holborn 4108. *'Grams:* Imvertret, Westcent

STOCK AND SHARE LIST.

Official Quotations on the London and Provincial Stock Exchanges.

Issue. £	Share.	When ex-Dividend.	Dividends. Prev. Hf. Yr. % p.a.	Dividends. Last Hf. Yr. % p.a.	NAME.	Quotations Nov. 10.	Rise or Fall on Week.	Transactions. Lowest and Highest Prices During the Week.
1,551,868	Stk.	Oct. 9	7	7	Alliance & Dublin Ord. ...	120—130	...	127—128
374,000	"	July 10	4	4	Do. 4 p.c. Deb. ...	85—95	...	...
557,655	"	Aug. 28	7	7	Barnet Ord. 7 p.c.	165—170	...	...
300,000	1	Oct. 23	1/9⅜	1/4⅜	Bombay, Ltd.	26/—28/-	+1/-	27/3
178,280	Stk.	Aug. 14	9½	9½	Bournemouth sliding scale	192—202	...	197
550,050	"	"	7	7	Do. 7 p.c. max. ...	163—168	...	...
439,160	"	"	6	6	Do. 6 p.c. Pref. ...	135—140	...	137½
50,000	"	June 26	3	3	Do. 3 p.c. Deb. ...	75—80	+1	...
162,025	"	"	4	4	Do. 4 p.c. Deb. ...	102—107	+2	104½—105½
210,000	"	"	5	5	Do. 5 p.c. Deb. ...	120—125	...	...
357,900	"	Aug. 28	7½	7½	Brighton, &c. 6 p.c. Con. ...	160—170	...	166—167
540,000	"	"	6⅜	6⅜	Do. 5 p.c. Con. ...	144—149	...	...
196,500	"	"	6	6	Do. 6 p.c. B Pref.	139—144	+4	140
1,487,500	"	July 24	5	5	Bristol 5 p.c. max.	112½—113½a	...	...
129,420	"	June 26	4	4	Do. 1st 4 p.c. Deb. ...	99—101a	...	...
217,870	"	"	4	4	Do. 2nd 4 p.c. Deb. ...	99—100a	...	...
328,790	"	"	5	5	Do. 5 p.c. Deb.	121—123a	...	...
855,000	"	Sept 25	8	7	British Ord.	159—164	...	160—162
100,000	"	June 26	7	7	Do. 7 p.c. Pref.	147—152	...	152
350,000	"	"	5½	5½	Do. 5½ p.c. Pref. ...	108—113	...	...
120,000	"	"	4	4	Do. 4 p.c. Red. Deb. ...	94—99	...	...
450,000	"	"	5	5	Do. 5 p.c. Red. Deb. ...	103—113	...	...
160,000	"	June 26	5	5	Cambridge 5 p.c. Deb. ...	115—120	...	...
100,000	10	May 22	6	4	Cape Town, Ltd.	7—8	...	...
100,000	10	Nov. 6	4½	4½	Do. 4½ p.c. Pref. ...	6¾—7¾*	—¼	...
150,000	Stk.	June 26	4½	4½	Do. 4½ p.c. Deb. ...	95—100	...	...
626,860	"	July 24	6	6	Cardiff Con. Ord.	117—122	...	...
237,860	"	June 26	5	5	Do. 5 p.c. Red. Deb.	105—110	...	...
157,150	"	Aug. 14	6½	5	Chester 5 p.c. Ord.	105—110b	...	...
98,936	1	Oct. 9	2/-	2/-	Colombo, Ltd. Ord.... ...	1 7/16—1 9/16	...	...
24,500	1	"	1/4⅜	1/4⅜	Do. 7 p.c. Pref. ...	18/6—20/6	...	...
609,204	1	Oct. 9	/11'48	/11'48	Colonial Gas Assn. Ltd. Ord.	1 5/16—1 7/16	+ 1/16	20/—20/6
296,053	1	"	1 3'80	1/3'80	Do. 8 p.c. Pref.	23/—25/-	+1/-	...
1,796,955	Stk.	July 24	6½	5	Commercial Ord.	120—125	...	120
475,000	"	June 12	3	3	Do. 3 p.c. Deb. ...	75—80	...	...
265,272	"	Mar. 6	—	5	Do. 5 p.c. Deb. ...	120—125	...	...
807,560	"	Aug. 14	7	7	Croydon sliding scale	147—152	...	...
469,590	"	"	5	5	Do. max. div.	105—110	...	...
500,000	"	July 10	5	5	Do. 5 p.c. Deb.	120—125	...	122—124
542,270	"	Mar. 6	7	10	Derby Con.	170—180e	...	...
5[illegible],000	"	July 10	4	4	Do. 4 p.c. Deb.	93—98e	...	...
209,000	"	Aug. 28	5	5	East Hull Ord. 5 p.c. ...	108—113	...	...
179,500	"	Aug. 28	6	6	East Surrey Ord. 5 p.c. ...	127—132	...	...
155,019	"	June 26	5	5	Do. 5 p.c. Deb. ...	117—122	...	121—121⅞
1,002,180	"	Sept 25	17	15	European, Ltd.	123—138	...	...
19,373,992	"	Aug 14	5⅝	5⅝	Gas Light & Coke 4 p.c. Ord.	27/3—28/3f	—/3	27/6—28/-
2,600,000	"	"	8¾	8¾	Do. 8¾ p.c. max.	86—89	+1	87½—88½
4,477,106	"	"	4	4	Do. 4 p.c. Con. Pref. ...	102—105	+1	103⅛—105
6,102,497	"	June 12	3	3	Do. 3 p.c. Con. Deb. ...	81—84	...	83—83⅜
3,642,770	"	"	5	5	Do. 5 p.c. Red. Deb. ...	115—118	...	116⅜—117⅜
3,500,000	"	"	4½	4½	Do. 4½ p.c. Red. Deb. ...	112—116	...	113¾—115
270,466	"	Aug. 28	6	6	Harrogate New Cons. ...	120—125	...	...
82,500	"	Aug. 28	7	7	Hastings & St. L. 5 p.c. Conv.	143—148	...	...
258,740	"	"	5½	5½	Do. 5½ p.c. Conv.	111—116	...	...
140,000	1	Oct. 9	110	1/7½	Hongkong & China, Ltd. ...	31/—33/-	...	...
218,200	Stk.	Aug. 14	6	6	Hornsey Con. 5½ p.c. ...	120—125	...	...
5,600,000	"	Nov. 6	10	10	Imperial Continental Cap.	200—210*	—7	200—210
223,130	"	Aug. 14	3½	3½	Do. 3½ p.c. Red. Deb.	90—95	...	94
285,242	"	Aug. 14	8½	8½	Lea Bridge 5 p.c. Ord. ...	167—172	...	...
2,145,907	"	Aug. 14	6	6	Liverpool 5 p.c. Ord. ...	130—132b	...	...
245,500	"	June 26	5	5	Do. 5 p.c. Red. Pref. ...	103—113b	...	...
306,083	"	July 17	4	4	Do. 4 p.c. Deb. ...	99½—101½b	...	...
165,786	"	Aug. 28	10	8	Maidstone 5 p.c. Cap. ...	180—190	...	...
56,176	"	July 10	3	3	Do. 3 p.c. Deb. ...	69—74	...	...
75,000	5	June 12	110	110	Malta & Mediterranean ... Metropolitan (of Melbourne)	9—11	...	...
392,000	—	Oct. 2	5½	5½	5½ p.c. Red. Deb.	98—103	...	...
231,978	Stk.	Aug. 28	5	5	M. S. Utility "C." Cons. ...	111—116	...	114½
818,657	"	"	4	4	Do. 4 p.c. Cons. Pref.	92—97	...	96
112,126	"	June 26	4	4	Do. 4 p.c. Deb. ...	100—105	...	...
148,955	"	"	5	5	Do. 5 p.c. Deb ...	113—118	...	...
675,000	"	21 May '31	16	16	Montevideo, Ltd.	62—72	...	...
2,061,315	"	Aug. 14	5⅜	5	Newcastle & Gateshead Con.	25/6—26/3d	...	...
682,856	"	"	4	4	Do. 4 p.c. Pref. ...	100—102d	+1	...
776,706	"	July 10	3½	3½	Do. 3½ p.c. Deb. ...	91—93d	...	...
277,285	"	May 8	5	5	Do. 5 p.c. Deb. '48...	107—109d	...	...
274,000	"	Aug. 14	5	5	Newport (Mon.) 5 p.c. max.	100—102a	...	...
204,940	"	Aug. 28	7½	7½	North Middlesex 5 p.c. Con.	153—158	...	...
396,160	"	Aug. 14	5	5	Northampton 5 p.c. max. ...	101—106	...	...
300,000	"	Apl. 24	9	7	Oriental, Ltd.	130—135	+5	127
316,617	"	June 26	8	8	Plym'th & Stonehouse 5 p.c.	167—172	...	169 171
504,416	"	Aug. 28	8	8	Portsm'th Con. Stk. 4 p.c. Std.	162—167	...	...
241,446	"	"	5	5	Do. 5 p.c. max. ...	102—107	...	...
114,000	"	Aug. 14	5	5	Preston 5 p.c. Pref.	101—106	...	...
686,312	"	July 24	4	4	Primitiva 4 p.c. Rd. Db. 1911	88—93	...	...
389,813	"	June 26	4	4	Do. 4 p.c. Cons. Deb.	98—93	...	...
150,000	10	Sept. 25	6	6	San Paulo 6 p.c. Pref. ...	6½—7½	...	...
1,736,968	Stk.	Sept. 11	6	6	Sheffield Cons.	134—136e	...	...
95,000	"	July 10	4	4	Do. 4 p.c. Deb.	90—91e	...	...
133,201	"	Sept. 11	5	8½	Shrewsbury 5 p.c. Ord. ...	132—137	...	...
90,000	10	June 12	15	14	South African	8—5	...	...
6,709,895	Stk.	Aug. 14	7	5	South Met. Ord.	133—136	...	134½—136
1,135,812	"	"	6	6	Do. 6 p.c. Irred. Pf.	135—140	...	...
850,000	"	"	20/-g	4	Do. 4 p.c. Irred. Pf.	101—104	...	103—103½
1,895,445	"	July 10	3	3	Do. 3 p.c. Deb. ...	80—83	...	...
1 000,000	"	July 24	5	5	Do. 5 p.c. Red. Deb.	112—116	...	115½
209,820	"	Aug. 14	8½	8½	South Shields Con.	171—173d	...	...
1,543,795	"	Aug. 14	6	6	South Suburban Ord. 5 p.c.	131—136	+1	133—134
300,000	"	"	5	5	Do. 5 p.c. Pref.	112—117	...	115—117
300,000	"	"	—	4	Do. 4 p.c. Pref.	100—103	...	102
868,837	"	June 26	5	5	Do. 5 p.c. Deb.	119—124	...	...
100,000	"	"	—	—	Do. 4 p.c. Deb.	102—105	...	...
647,740	"	Aug. 28	5	5	Southampt'n Ord. 5 p.c. max.	107—112	...	...
121,275	"	June 26	4	4	Do. 4 p.c. Deb.	99—104	...	...
350,000	"	Aug. 28	5½	5½	Swansea 5½ p.c. Red. Pref.	107—111	...	...
200,000	"	June 26	6½	6½	Do. 6½ p.c. Red. Deb.	103—108	...	...
1,076,490	"	Aug. 14	6⅜	6⅜	Tottenham and District Ord.	148—153	...	151
300,000	"	"	5½	5½	Do. 5½ p.c. Pref. ...	124—129	...	...
62,285	"	"	5	5	Do. 5 p.c. Pref. ...	112—117	...	...
199,005	"	June 12	4	4	Do. 4 p.c. Deb. ...	98—103	...	100
85,701	"	Oct. 9	6	6	Tuscan, Ltd., 5 p.c. Red. Db.	90—100	...	...
347,769	"	Aug. 28	7	7	Uxbridge, &c., 5 p.ct. ...	144—149	...	142—150
88,330	"	"	5	5	Do. 5 p.c. Pref. ...	112—117	...	...
1,322,220	"	July 10	7	7	Wandsworth Consolidated	153—158	...	156—157
1,096,373	"	"	5	5	Do. 5 p.c. Pref.	117—122	...	...
1,317,964	"	June 26	5	5	Do. 5 p.c. Deb.	118—123	...	...
158,400	"	Aug. 28	6A	5	Winchester W. & G. 5p.c. Con.	107—112	...	...

Quotations at:—*a.*—Bristol. *b.*—Liverpool. *c.*—Nottingham. *d.*—Newcastle. *e.*—Sheffield. *f*—The quotation is per £1 of stock *g.*—For quarter. *h.*—Paid £3, including 10s. on account of back dividends. *i.*—The interest due 1/7/33 was paid on that date. * Ex. div. † Paid free of income-tax. ‡ For year. Hongkong & China, Ltd.—paid on £10 shares.

STOCK FOR SALE BY TENDER.

By Order of the Directors.

BIDEFORD GAS AND COKE COMPANY, LIMITED.

Messrs. A. & W. RICHARDS

are Instructed to OFFER FOR SALE BY TENDER

1200 £10

FIVE PER CENT. CUMULATIVE PREFERENCE SHARES.

Minimum Price of Issue, £11 per Share.

Yielding at that price, £4 10s. 11d. per cent.

Prospectus and Form of Tender (which latter must be sent in by 11 o'clock on Tuesday, 21st November) may be obtained of A. & W. RICHARDS, 37, WALBROOK, E.C. 4.

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COMPREHENSIVE, UNBIASED REPORTS
25 Years' Experience
LEONARD BOTT, GRANVILLE VILLAS, NEWPORT, Shropshire

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Manufacturers of GAS RETORTS, GLASSHOUSE FURNACE & BLAST FURNACE BRICKS, LUMPS, TILES, and every Description of FIRE BRICKS.

Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.

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BUFFALO INJECTOR
(British Made) **CLASS A**
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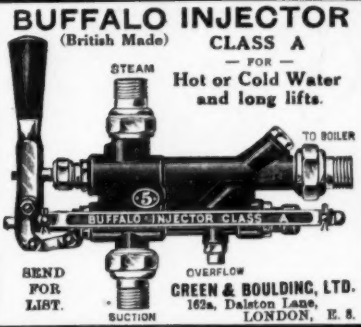

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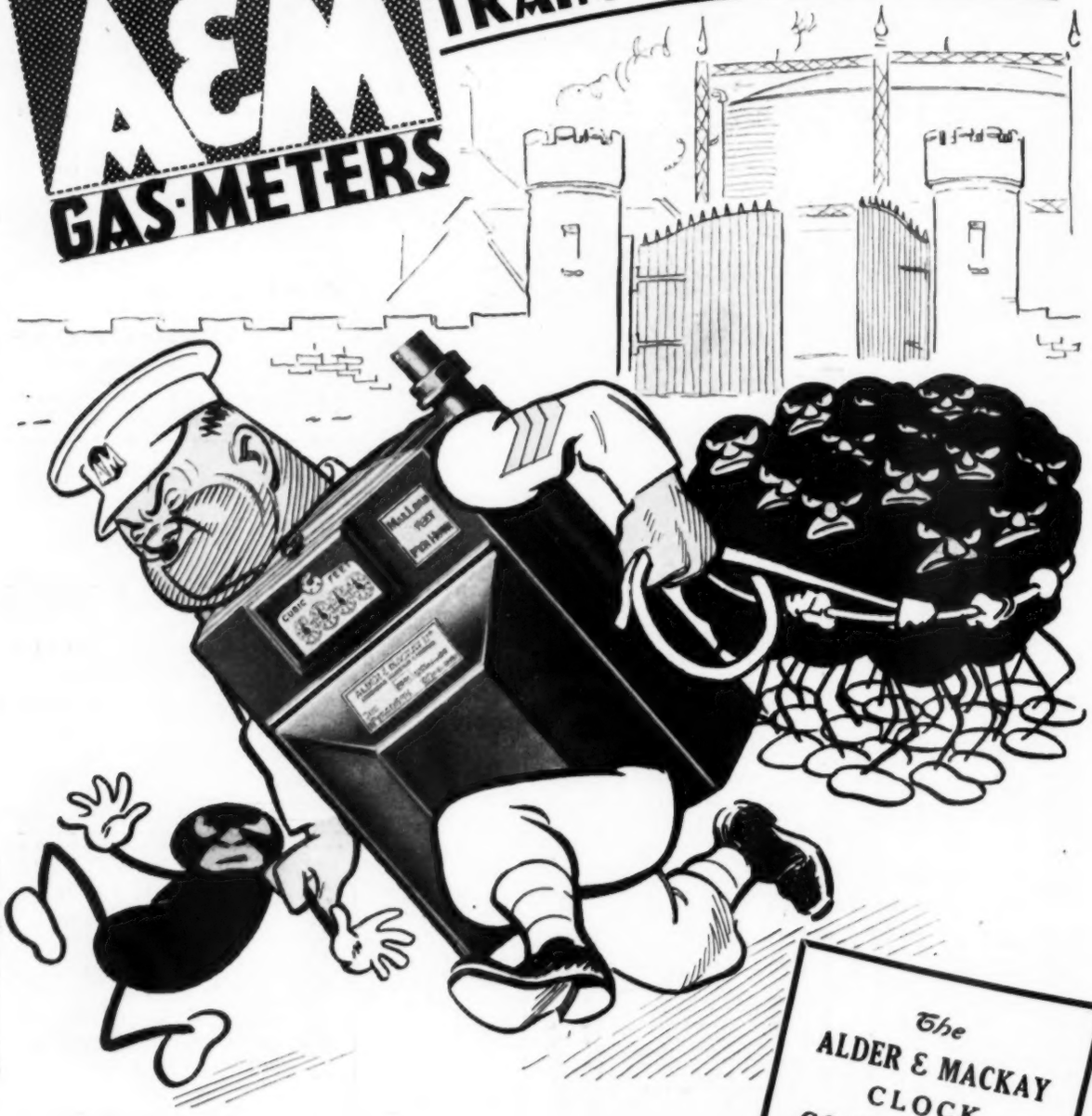

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In Bulk for Works Use.
(See also p. 5 (Oct. 4) and the "Gas Salesman.")

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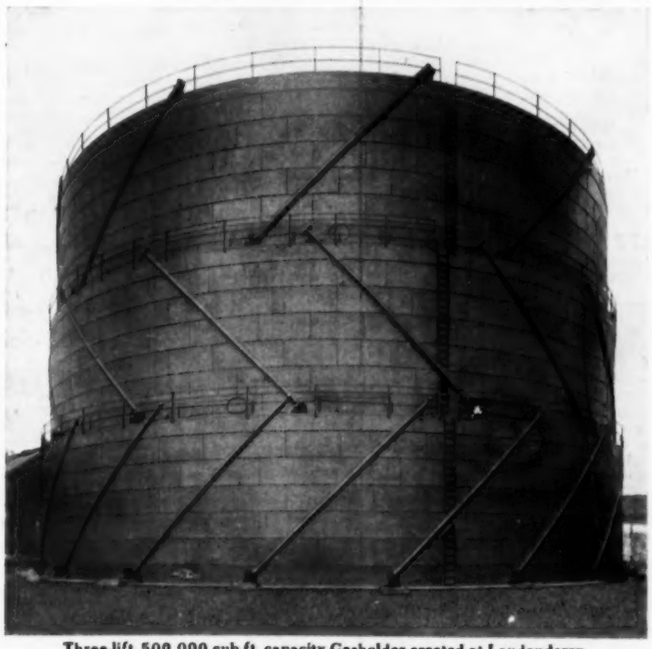

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COUNTY COUNCIL OF THE COUNTY OF LANARK.
(GAS DEPARTMENT.)

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APPLICATIONS are invited for the Position of WORKS MANAGER at Cambuslang Gas-Works.

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The person appointed will have charge of the Cambuslang Works, High-Pressure Mains, and the Distribution and Sale of Gas in the local supply area, and will be required to devote the whole of his time to the duties of the Office.

The Salary will be at the rate of £350 per Annum, *less* an economy cut of 5 per cent. The appointment will be subject to the provisions of the Local Government and Other Officers' Superannuation Act, 1922.

Applications, with *copies* of Testimonials, stating Age, Experience, and Training, and endorsed "Gas-Works Manager," should be addressed to the undersigned on or before Thursday, 23rd November, 1933.

J. MCGHIE,
ROBERT BRYCE WALKER,
County Clerks.

Lanarkshire House,
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Glasgow

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J. WESLEY WHIMSTER,
Engineer and Manager.

Gas-Works,
Bath.

WANTED, by Firm of Gas Stove Manufacturers, REPRESENTATIVE for the Midlands from Birmingham Eastward to the Coast.

Write, stating Age, Experience, whether in employment, and starting Salary required, to No. 8366, "GAS JOURNAL," 11, BOLT COURT, FLEET STREET, E.C. 4.

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Duke Street,
Liverpool,
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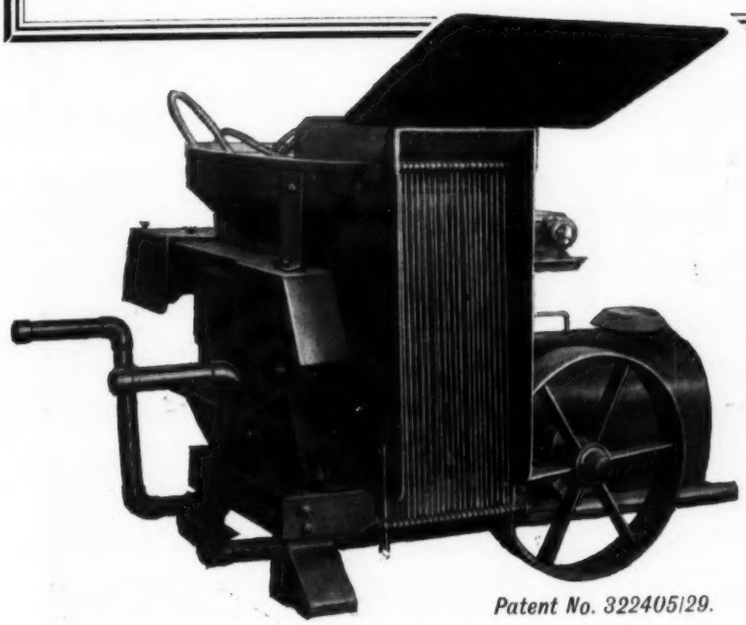

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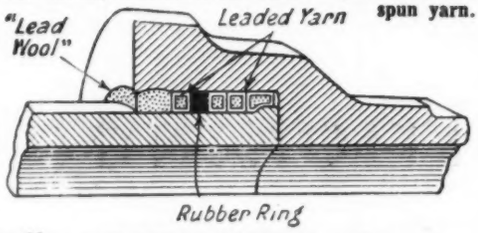

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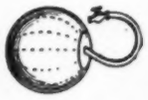
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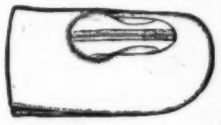
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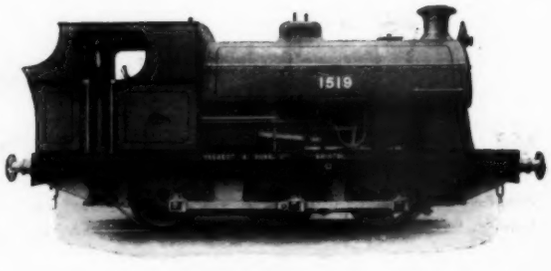

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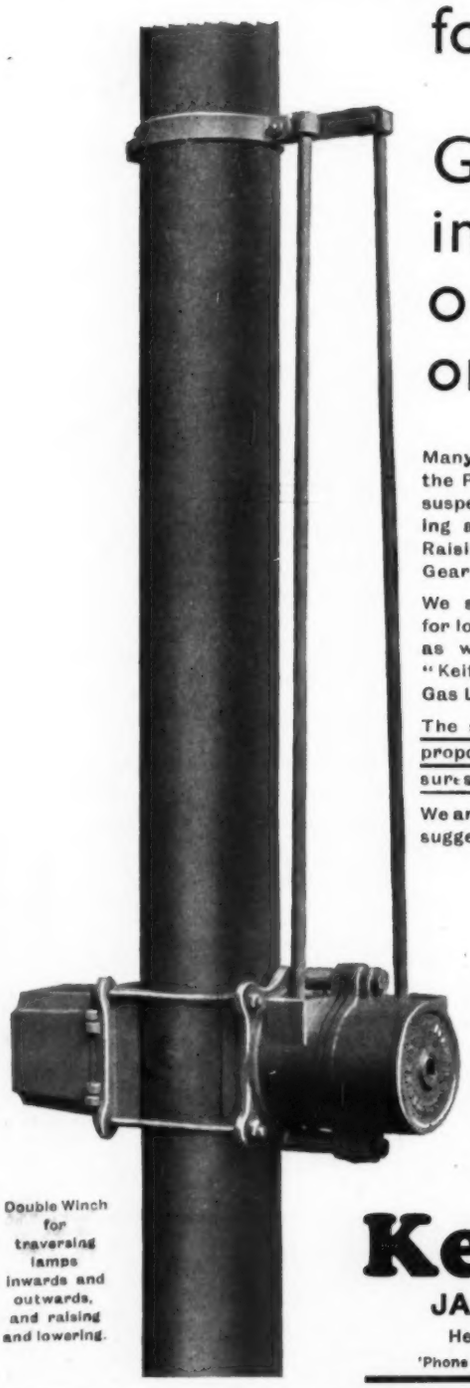

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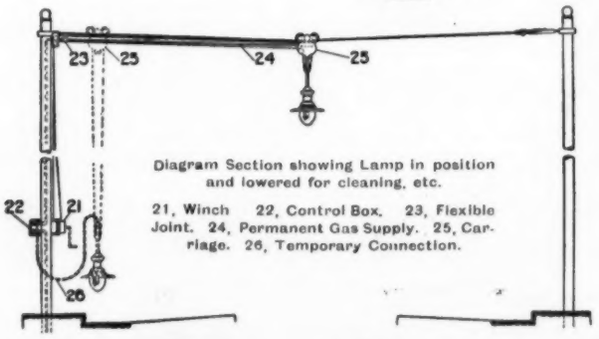

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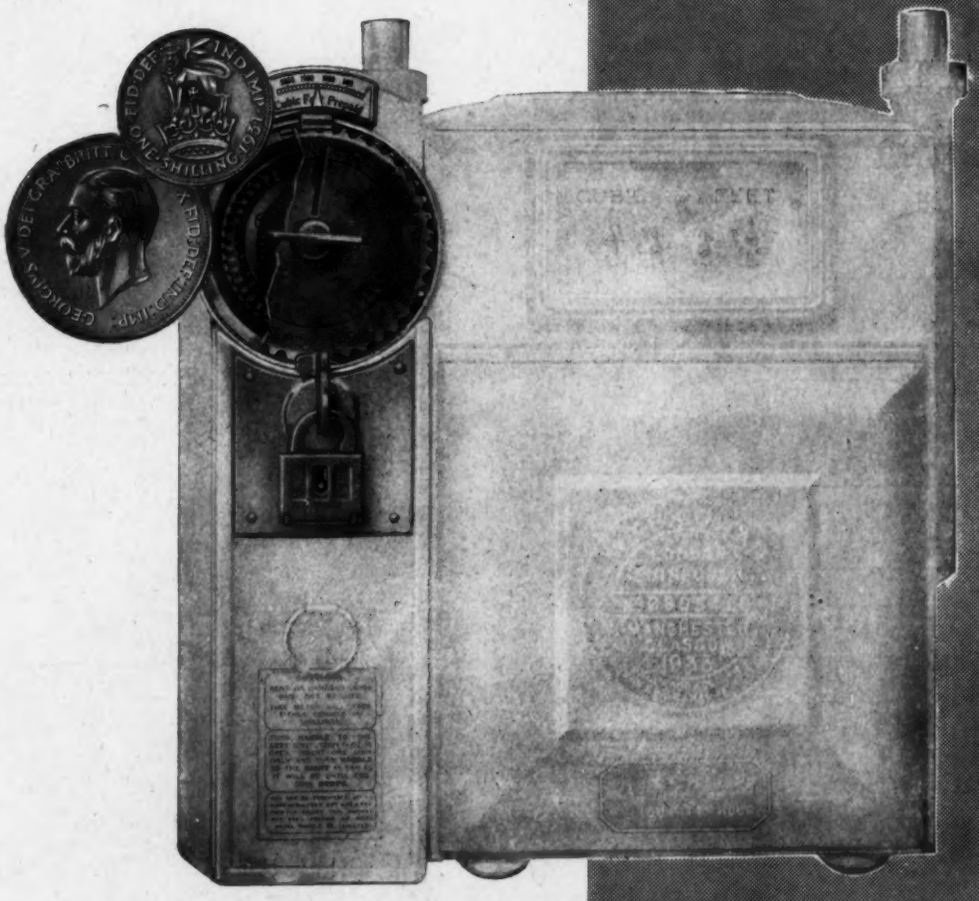

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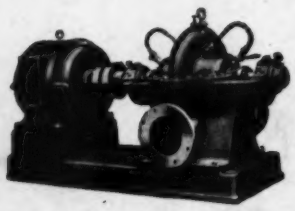

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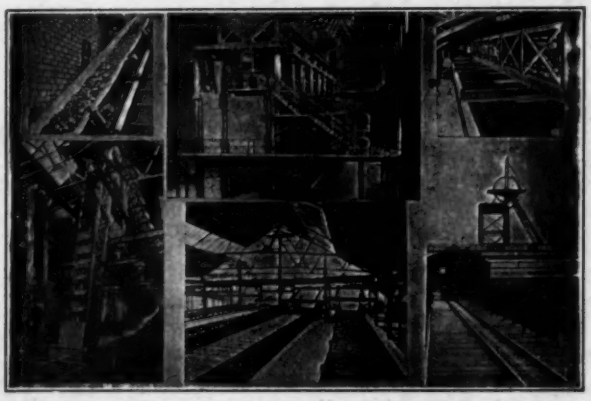

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